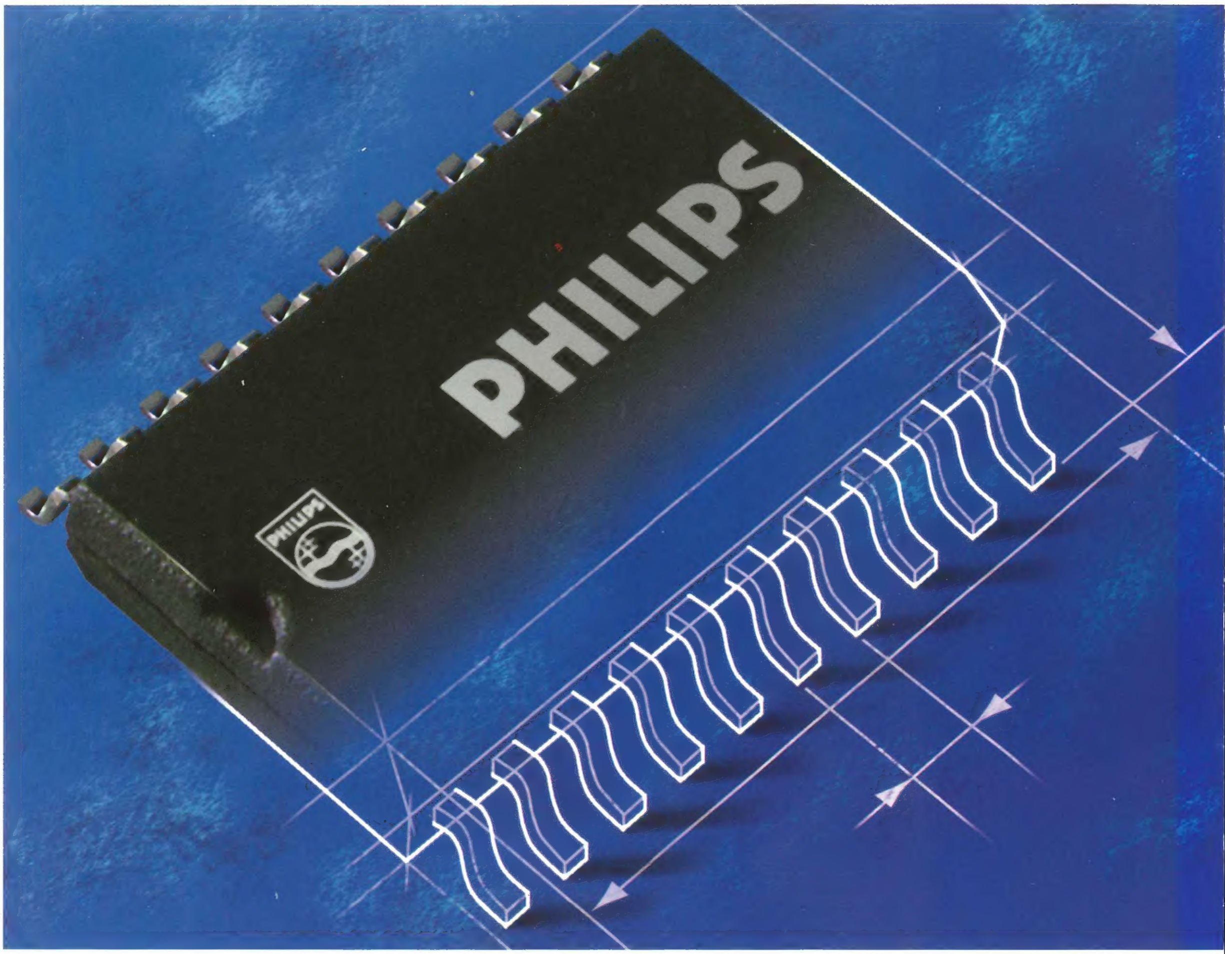
INTEGRATED CIRCUITS

IC Package Databook



1995

Philips Semiconductors

PHILIPS

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Welcome to the first IC Package Databook of its kind issued by Philips Semiconductors. The book's publication is in direct response to the many requests received by our customers and contains detailed information about all aspects of our IC packages, from dimensioned outline drawings and footprint designs, to thermal design considerations, packing data, and chemical content tables. It should be viewed as a logical extension to our IC Data Handbook series and, as such, is intended to serve as a practical data reference to all those involved in production and engineering design, as well as a guide to package selection and availability.

IC PACKAGE TRENDS

Since the first integrated circuits were manufactured, the number of devices that have been successfully integrated onto a single die or chip of silicon has approximately doubled every eighteen months or so – an increase of some one hundred fold every decade. Today, ICs containing as many as two million transistors are readily available, and this trend towards ever greater integration and functional complexity shows every sign of continuing.

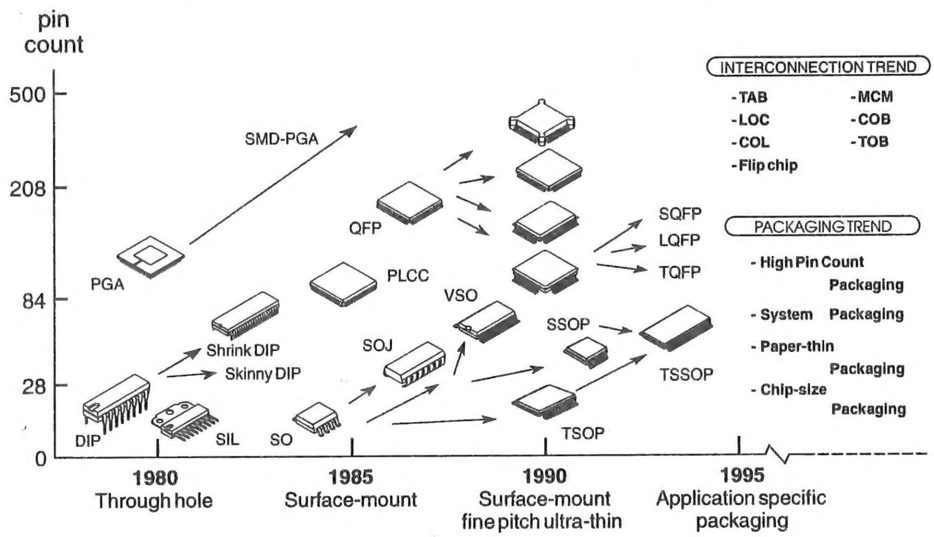
With such high integration densities, the IC package design has become increasingly more important in determining, not only the size of the component, but also its overall performance and functionality. Higher lead count, smaller pitch, minimum footprint area and reduced component volume all contribute to a more compact circuit assembly. As a consequence, when designing and manufacturing printed circuit boards, their dimensions and tolerances are perhaps more crucial than ever before.

Furthermore, as the package directly affects factors such as heat dissipation and frequency dependency, a good design is essential in optimizing IC performance.

AN INNOVATIVE PARTNER

Here at Philips Semiconductors, we have been involved in IC design and development since the early 1960's, during which time we have built up a wealth of expertise and know-how in advanced process technologies and IC packaging and assembly procedures. By fully exploiting this expertise, and establishing close working partnerships with our customers, we have developed many market-driven and innovative products. This is backed up by our worldwide network of application laboratories which are geared to meeting, and often anticipating, customer requirements.

One example of this was our work on, and commitment to, surface mount technology back in the mid-1980's which has since revolutionized equipment manufacture. Using Surface Mount Devices (SMDs), a circuit can be just one-sixth the size of a conventional assembly with through-hole components, or the component density can be increased to give more functions within the same space. This, coupled with fast, automated assembly for which SMDs are designed, offers the double advantage of improved products and reduced production costs.



Worldwide IC package trends

OUR IC PACKAGING POLICY

We can summarize our work into IC package development in the following four-point policy:

- Market and application driven package development
- Innovation in miniaturization and system solutions
- Focus on flexibility, low cost and high quality
- Designs according to IEC, JEDEC and EIAJ standards.

HOW THIS BOOK IS ORGANIZED

We organized this databook into the following chapters:

Chapter 1 gives an overview of all our IC packages, classified by type in a family tree with a photograph of each type.

Chapter 2 contains outline dimensional drawings for most of our IC packages. It also lists all the packages in ascending order of package name *and* Philips outline code (SOT number).

Chapter 3 reviews IC handling precautions with emphasis on ESD precautions.

Chapters 4 and 5 look at through-hole and SMD mounting and soldering techniques, and include recommended footprint designs for most SMD packages.

Chapter 6 surveys Philips' surface mounting equipment.

Chapter 7 discusses thermal design considerations.

Chapter 8 explains the packing methods used for ICs with exploded views, packing quantities, weights and markings.

Chapter 9 provides comprehensive data on the chemical composition of our ICs with information on their disposal and safety.

WE WANT TO HEAR FROM YOU!

Philips Semiconductors is committed to continually improving its products and services (and that includes this databook). On the following page you'll find a "Customer's Response Page", if you find any errors, oversights or omissions in this edition, or indeed if you have any ideas on how we could improve future updates of the book, fill it in and fax or send a copy of it to us.

CUSTOMER'S RESPONSE PAGE

As we intent to update this book at regular intervals, we encourage you to use this page to list any errors or omissions you may come across, or any ideas you may have on how we could improve future editions of this book. Please feel free to copy this page, and if necessary the page on which your comments refer, and fax or send to:

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Please list below any comments you have that may be useful for future editions of *IC Package Databook*.

PACKAGE CLASSIFICATIONS

IC Packages are classified by board mounting method and type as shown in Fig.1.1.

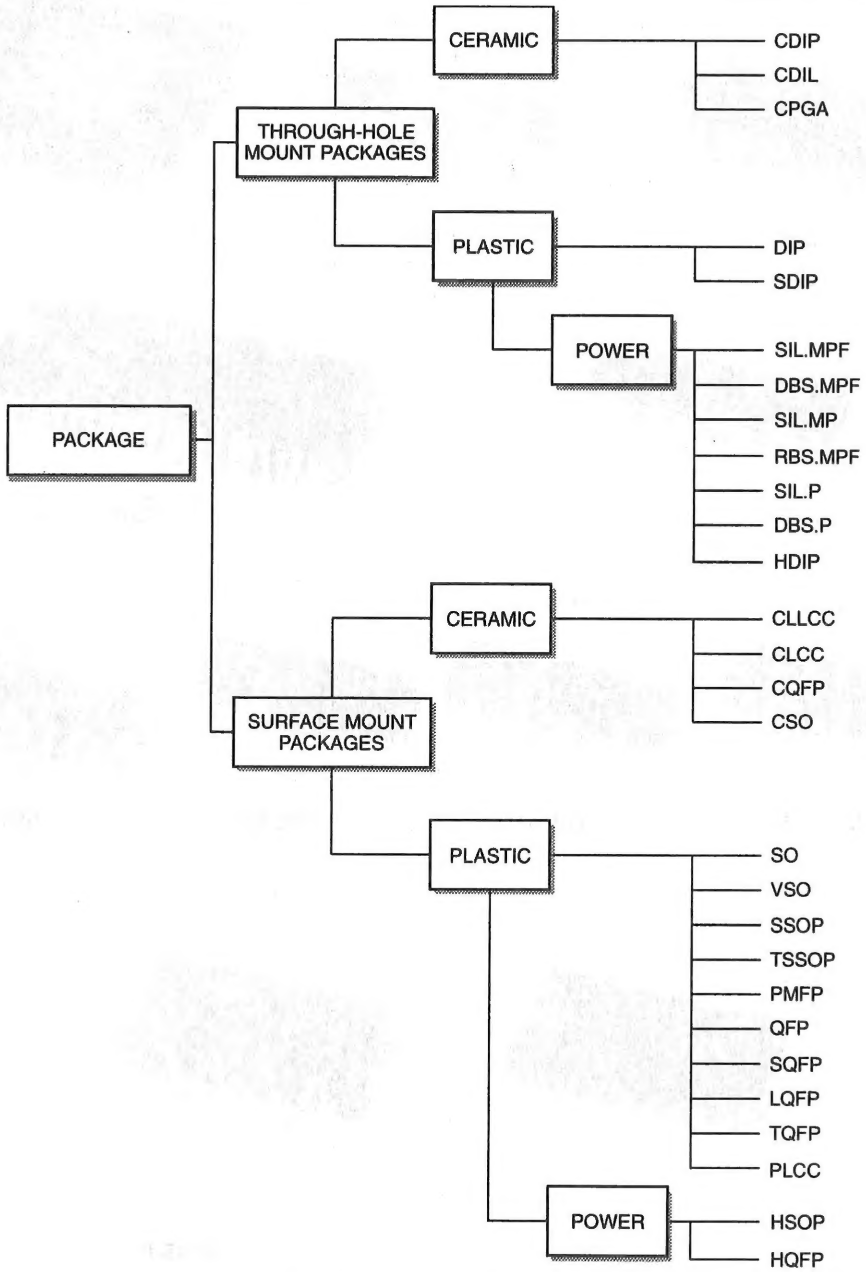
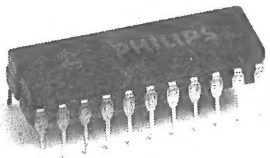
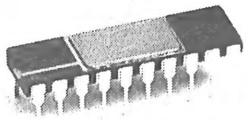


Fig.1.1 Package classification

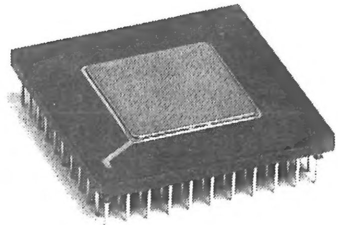
THROUGH-HOLE MOUNT PACKAGES



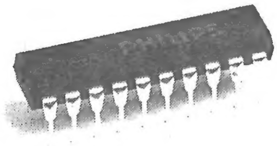
CDIP



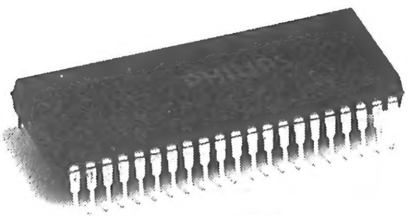
CDIL



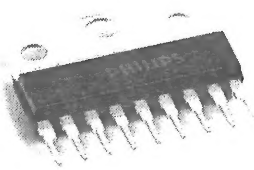
CPGA



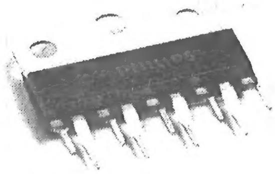
DIP
HDIP



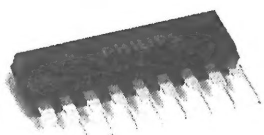
SDIP



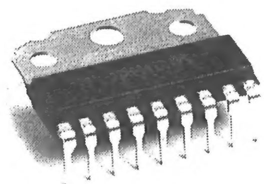
SIL.MPF



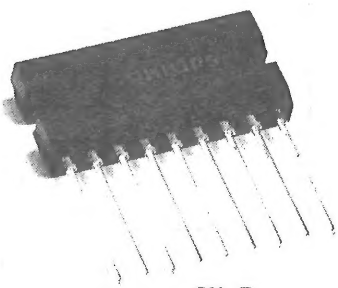
DBS.MPF



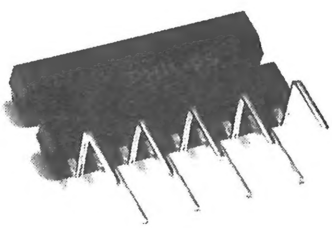
SIL.MP



RBS.MPF

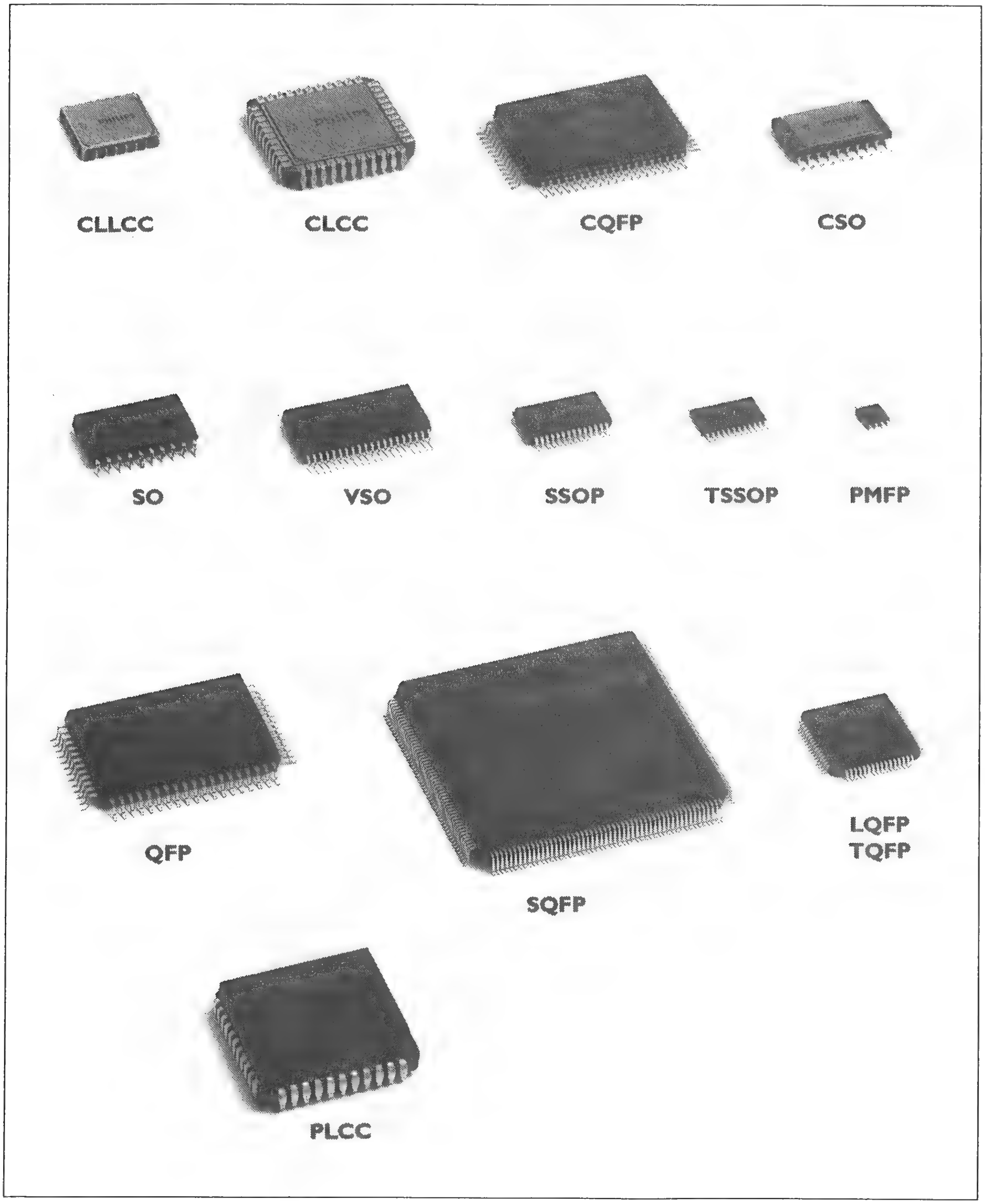


SIL.P



DBS.P

SURFACE MOUNT PACKAGES



PACKAGE TYPE OVERVIEW

Through-Hole Mount Packages

Package name	Number of leads																								
	8	9	13	14	16	17	18	20	22	24	28	32	40	42	44	48	50	52	63	64	68	84	108	120	144
CDIP	●			●	●		●	●	●	●	●		●												
CDIL					●		●	●		●	●		●												
CPGA															●				●	●	●	●	●	●	●
DIP	●			●	●		●	●	●	●	●	●	●			●	●			●					
SDIP								●		●		●		●				●		●					
SIL.MPF		●																							
DBS.MPF		●																							
SIL.MP		●																							
RBS.MPF		●																							
SIL.P		●	●																						
DBS.P		●	●			●																			
HDIP							●																		

Surface Mount Packages

Package name	Number of leads																							
	8	9	14	16	20	24	28	32	36	40	44	48	52	56	64	68	80	84	100	120	128	132	160	208
CLLCC					●	●	●																	
CLCC											●					●		●						
CQFP								●		●		●			●		●					●		
CSO				●	●	●	●																	
SO	●		●	●	●	●	●	●																
VSO										●				●										
SSOP			●	●	●	●	●		●			●		●										
TSSOP			●	●	●	●	●					●		●										
PMFP	●																							
QFP											●	●	●		●		●		●	●	●		●	
SQFP																					●			●
LQFP								●			●	●			●		●							
TQFP											●				●		●		●					
PLCC					●		●	●			●		●			●		●						
HSOP	In development																							
HQFP	In development																							

IC Package Range and Dimensions

The following table lists all our IC packages in alphanumeric order, and includes the SOT number, a brief description of the package and the page number on which you'll find the outline drawing. A similar list in ascending order of SOT numbers (for cross-reference purposes) is given on page 2–8.

PACKAGES IN ASCENDING ORDER OF PACKAGE NAME

Package name	Philips outline code	Description	Page
Ceramic dual in-line package (CDIL)			
CDIL16	SOT84-2	16 leads; metal seal	see note
CDIL16	SOT84-4	16 leads; metal seal	see note
CDIL18	SOT85-1	18 leads; metal seal	see note
CDIL20	SOT154-1	20 leads; metal seal	see note
CDIL24	SOT86-2	24 leads; metal seal	see note
CDIL28	SOT87-2	28 leads; metal seal	see note
CDIL28	SOT217-1	28 leads; metal seal	see note
CDIL40	SOT88-2	40 leads; metal seal	see note
Ceramic dual in-line package (CDIP)			
CDIP8	SOT151-1	8 leads; glass seal	see note
CDIP8	SOT151-2	8 leads; glass seal	see note
CDIP14	SOT73-1	14 leads; glass seal	see note
CDIP14	SOT73-3	14 leads; glass seal	see note
CDIP14	SOT73-2	14 leads; glass seal	see note
CDIP16	SOT74-1	16 leads; glass seal	see note
CDIP16	SOT74-2	16 leads; glass seal	see note
CDIP16	SOT74-3	16 leads; glass seal	see note
CDIP18	SOT133-1	18 leads; glass seal	see note
CDIP20	SOT152-2	20 leads; glass seal	see note
CDIP22	SOT134-1	22 leads; glass seal	see note
CDIP24	SOT94-1	24 leads; glass seal	see note
CDIP24	SOT94-2	24 leads; glass seal	see note
CDIP28	SOT135-1	28 leads; glass seal	see note
CDIP40	SOT145-1	40 leads; glass seal	see note
CDIP40	SOT145-2	40 leads; glass seal	see note

Note: Although an outline drawing is not given in this databook, it is available on request.

Package name	Philips outline code	Description	Page
Ceramic leaded chip carrier			
CLCC44	SOT326-1	44 leads	see note
CLCC68	SOT327-1	68 leads	see note
CLCC68	SOT327-2	68 leads	see note
CLCC68	SOT327-3	68 leads	see note
CLCC84	SOT335-1	84 leads	see note
Ceramic leadless chip carrier			
CLLCC20	SOT256-1	20 connecting pads	see note
CLLCC24	SOT175-1	24 connecting pads	see note
CLLCC28	SOT255-1	28 connecting pads	see note
Ceramic pin grid array			
CPGA44	SOT309-1	44 pins	see note
CPGA63	SOT293-1	63 pins; face down	see note
CPGA63	SOT293-3	63 pins; face down	see note
CPGA63	SOT293-4	63 pins; face down	see note
CPGA64	SOT169-1	64 pins	see note
CPGA64	SOT245-1	64 pins; face down	see note
CPGA68	SOT257-1	68 pins	see note
CPGA84	SOT258-1	84 pins	see note
CPGA108	SOT265-1	108 pins	see note
CPGA120	SOT259-1	120 pins	see note
CPGA144	SOT260-1	144 pins	see note
Ceramic quad flat package			
CQFP32	SOT345-1	32 leads	see note
CQFP40	SOT328-1	40 leads	see note
CQFP48	SOT292-1	48 leads	see note
CQFP64	SOT329-1	64 leads	see note
CQFP80	SOT351-1	80 leads	see note
CQFP132	SOT356-1	132 leads	see note

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Package name	Philips outline code	Description	Page
Shrink dual in-line package			
SDIP20	SOT325-1	Plastic package; 20 leads (300 mil)	2 – 80
SDIP24	SOT234-1	Plastic package; 24 leads (400 mil)	2 – 81
SDIP32	SOT232-1	Plastic package; 32 leads (400 mil)	2 – 82
SDIP42	SOT270-1	Plastic package; 42 leads (600 mil)	2 – 83
SDIP52	SOT247-1	Plastic package; 52 leads (600 mil)	2 – 84
SDIP64	SOT274-1	Plastic package; 64 leads (750 mil)	2 – 85
Single in-line power package			
SIL9P	SOT131-2	Plastic package; 9 leads	2 – 86
SIL13P	SOT193-2	Plastic package; 13 leads	2 – 87
Single in-line medium power package			
SIL9MP	SOT142-1	Plastic package; 9 leads	2 – 88
Single in-line medium power package with fin			
SIL9MPF	SOT110-1	Plastic package; 9 leads	2 – 89
Small outline package			
SO8	SOT96-1	Plastic package; 8 leads; body width 3.9 mm	2 – 90
SO8	SOT96-2	Plastic package; 8 leads (straight); body width 3.9 mm	2 – 91
SO8	SOT176-1	Plastic package; 8 leads; body width 7.5 mm	2 – 92
SO14	SOT108-1	Plastic package; 14 leads; body width 3.9 mm	2 – 93
SO16	SOT109-1	Plastic package; 16 leads; body width 3.9 mm	2 – 94
SO16	SOT109-2	Plastic package; 16 leads; body width 3.9 mm; low stand-off height	2 – 95
SO16	SOT162-1	Plastic package; 16 leads; body width 7.5 mm	2 – 96
SO20	SOT163-1	Plastic package; 20 leads; body width 7.5 mm	2 – 97
SO24	SOT137-1	Plastic package; 24 leads; body width 7.5 mm	2 – 98
SO28	SOT136-1	Plastic package; 28 leads; body width 7.5 mm	2 – 99
SO28	SOT213-1	Plastic package; 28 leads; body width 8.4 mm	2 – 100
SO32	SOT287-1	Plastic package; 32 leads; body width 7.5 mm	2 – 101
Shrink quad flat package			
SQFP128	SOT387-1	Plastic package; 128 leads (lead length 1.6 mm); body 14 × 20 × 2.0 mm	see note
SQFP208	SOT316-1	Plastic package; 208 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm	2 – 102

Note: Although an outline drawing is not given in this databook, it is available on request.

Package name	Philips outline code	Description	Page
Shrink small outline package			
SSOP14	SOT337-1	Plastic package; 14 leads; body width 5.3 mm	2 – 103
SSOP16	SOT338-1	Plastic package; 16 leads; body width 5.3 mm	2 – 104
SSOP16	SOT369-1	Plastic package; 16 leads; body width 4.4 mm	2 – 105
SSOP20	SOT266-1	Plastic package; 20 leads; body width 4.4 mm	2 – 106
SSOP20	SOT339-1	Plastic package; 20 leads; body width 5.3 mm	2 – 107
SSOP24	SOT340-1	Plastic package; 24 leads; body width 5.3 mm	2 – 108
SSOP28	SOT341-1	Plastic package; 28 leads; body width 5.3 mm	2 – 109
SSOP36	SOT378-1	Plastic package; 36 leads; body width 7.5 mm; lead pitch 0.8 mm	2 – 110
SSOP48	SOT370-1	Plastic package; 48 leads; body width 7.5 mm	2 – 111
SSOP56	SOT371-1	Plastic package; 56 leads; body width 7.5 mm	2 – 112
Thin quad flat package			
TQFP44	SOT376-1	Plastic package; 44 leads; body 10 × 10 × 1.0 mm	see note
TQFP64	SOT357-1	Plastic package; 64 leads; body 10 × 10 × 1.0 mm	see note
TQFP80	SOT375-1	Plastic package; 80 leads; body 12 × 12 × 1.0 mm	see note
TQFP100	SOT386-1	Plastic package; 100 leads; body 14 × 14 × 1.0 mm	see note
Thin shrink small outline package			
TSSOP14	SOT402-1	Plastic package; 14 leads; body width 4.4 mm	see note
TSSOP16	SOT403-1	Plastic package; 16 leads; body width 4.4 mm	see note
TSSOP20	SOT360-1	Plastic package; 20 leads; body width 4.4 mm	2 – 113
TSSOP24	SOT355-1	Plastic package; 24 leads; body width 4.4 mm	2 – 114
TSSOP28	SOT361-1	Plastic package; 28 leads; body width 4.4 mm	see note
TSSOP48	SOT362-1	Plastic package; 48 leads; body width 6.1 mm	see note
TSSOP56	SOT364-1	Plastic package; 56 leads; body width 6.1 mm	see note
Very small outline package			
VSO40	SOT158-1	Plastic package; 40 leads	2 – 115
VSO40	SOT158-2	Plastic package; 40 leads; face down	2 – 116
VSO56	SOT190-1	Plastic package; 56 leads	2 – 117

Note: Although an outline drawing is not given in this databook, it is available on request.

PACKAGES IN ASCENDING ORDER OF PHILIPS OUTLINE CODE (SOT NUMBER)

Philips outline code	Package name	Description	Page
SOT27-1	DIP14	Plastic dual in-line package; 14 leads (300 mil)	2 – 23
SOT38-1	DIP16	Plastic dual in-line package; 16 leads (300 mil); long body	2 – 24
SOT38-4	DIP16	Plastic dual in-line package; 16 leads (300 mil)	2 – 25
SOT73-1	CDIP14	Ceramic dual in-line package; 14 leads; glass seal	see note
SOT73-2	CDIP14	Ceramic dual in-line package; 14 leads; glass seal	see note
SOT73-3	CDIP14	Ceramic dual in-line package; 14 leads; glass seal	see note
SOT74-1	CDIP16	Ceramic dual in-line package; 16 leads; glass seal	see note
SOT74-2	CDIP16	Ceramic dual in-line package; 16 leads; glass seal	see note
SOT74-3	CDIP16	Ceramic dual in-line package; 16 leads; glass seal	see note
SOT84-2	CDIL16	Ceramic dual in-line package; 16 leads; metal seal	see note
SOT84-4	CDIL16	Ceramic dual in-line package; 16 leads; metal seal	see note
SOT85-1	CDIL18	Ceramic dual in-line package; 18 leads; metal seal	see note
SOT86-2	CDIL24	Ceramic dual in-line package; 24 leads; metal seal	see note
SOT87-2	CDIL28	Ceramic dual in-line package; 28 leads; metal seal	see note
SOT88-2	CDIL40	Ceramic dual in-line package; 40 leads; metal seal	see note
SOT94-1	CDIP24	Ceramic dual in-line package; 24 leads; glass seal	see note
SOT94-2	CDIP24	Ceramic dual in-line package; 24 leads; glass seal	see note
SOT96-1	SO8	Plastic small outline package; 8 leads; body width 3.9 mm	2 – 90
SOT96-2	SO8	Plastic small outline package; 8 leads (straight); body width 3.9 mm	2 – 91
SOT97-1	DIP8	Plastic dual in-line package; 8 leads (300 mil)	2 – 22
SOT101-1	DIP24	Plastic dual in-line package; 24 leads (600 mil)	2 – 31
SOT101-2	DIP24	Plastic dual in-line package; 24 leads (600 mil); short leads	2 – 32
SOT102-1	DIP18	Plastic dual in-line package; 18 leads (300 mil)	2 – 26
SOT102-2	DIP18	Plastic dual in-line package; 18 leads (300 mil); slim corner leads	2 – 27
SOT102-4	DIP18	Plastic dual in-line package; 18 leads (300 mil); long body	2 – 28
SOT108-1	SO14	Plastic small outline package; 14 leads; body width 3.9 mm	2 – 93
SOT109-1	SO16	Plastic small outline package; 16 leads; body width 3.9 mm	2 – 94

Note: Although an outline drawing is not given in this databook, it is available on request.

Philips outline code	Package name	Description	Page
SOT109-2	SO16	Plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height	2 – 95
SOT110-1	SIL9MPF	Plastic single in-line medium power package with fin; 9 leads	2 – 89
SOT111-1	DBS9MPF	Plastic DIL-bent-SIL medium power package with fin; 9 leads	2 – 21
SOT116-1	DIP22	Plastic dual in-line package; 22 leads (400 mil)	2 – 30
SOT117-1	DIP28	Plastic dual in-line package; 28 leads (600 mil)	2 – 35
SOT117-2	DIP28	Plastic dual in-line package; 28 leads (600 mil); long body	2 – 36
SOT129-1	DIP40	Plastic dual in-line package; 40 leads (600 mil)	2 – 39
SOT131-2	SIL9P	Plastic single in-line power package; 9 leads	2 – 86
SOT133-1	CDIP18	Ceramic dual in-line package; 18 leads; glass seal	see note
SOT134-1	CDIP22	Ceramic dual in-line package; 22 leads; glass seal	see note
SOT135-1	CDIP28	Ceramic dual in-line package; 28 leads; glass seal	see note
SOT136-1	SO28	Plastic small outline package; 28 leads; body width 7.5 mm	2 – 99
SOT137-1	SO24	Plastic small outline package; 24 leads; body width 7.5 mm	2 – 98
SOT141-6	DBS13P	Plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	2 – 17
SOT141-8	DBS13P	Plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm)	2 – 18
SOT142-1	SIL9MP	Plastic single in-line medium power package; 9 leads	2 – 88
SOT144-1	PMFP8	Plastic micro flat package; 8 leads (straight)	2 – 60
SOT145-1	CDIP40	Ceramic dual in-line package; 40 leads; glass seal	see note
SOT145-2	CDIP40	Ceramic dual in-line package; 40 leads; glass seal	see note
SOT146-1	DIP20	Plastic dual in-line package; 20 leads (300 mil)	2 – 29
SOT151-1	CDIP8	Ceramic dual in-line package; 8 leads; glass seal	see note
SOT151-2	CDIP8	Ceramic dual in-line package; 8 leads; glass seal	see note
SOT152-2	CDIP20	Ceramic dual in-line package; 20 leads; glass seal	see note
SOT154-1	CDIL20	Ceramic dual in-line package; 20 leads; metal seal	see note
SOT157-2	DBS9P	Plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm)	2 – 15
SOT157-4	DBS9P	Plastic DIL-bent-SIL power package; 9 leads (lead length 7.7 mm)	2 – 16
SOT158-1	VSO40	Plastic very small outline package; 40 leads	2 – 115

Note: Although an outline drawing is not given in this databook, it is available on request.

Philips outline code	Package name	Description	Page
SOT158-2	VSO40	Plastic very small outline package; 40 leads; face down	2 – 116
SOT162-1	SO16	Plastic small outline package; 16 leads; body width 7.5 mm	2 – 96
SOT163-1	SO20	Plastic small outline package; 20 leads; body width 7.5 mm	2 – 97
SOT169-1	CPGA64	Ceramic pin grid array; 64 pins	see note
SOT175-1	CLLCC24	Ceramic leadless chip carrier; 24 connecting pads	see note
SOT176-1	SO8	Plastic small outline package; 8 leads; body width 7.5 mm	2 – 92
SOT187-2	PLCC44	Plastic leaded chip carrier; 44 leads	2 – 53
SOT188-2	PLCC68	Plastic leaded chip carrier; 68 leads	2 – 56
SOT188-3	PLCC68	Plastic leaded chip carrier; 68 leads; pedestal	2 – 57
SOT189-2	PLCC84	Plastic leaded chip carrier; 84 leads	2 – 58
SOT189-3	PLCC84	Plastic leaded chip carrier; 84 leads; pedestal	2 – 59
SOT190-1	VSO56	Plastic very small outline package; 56 leads	2 – 117
SOT193-2	SIL13P	Plastic single in-line power package; 13 leads	2 – 87
SOT196-1	QFP48	Plastic quad flat package; 48 leads (lead length 2.5 mm); body 10 × 10 × 1.75 mm	see note
SOT201-1	DIP32	Plastic dual in-line package; 32 leads (600 mil)	2 – 38
SOT205-1	QFP44	Plastic quad flat package; 44 leads (lead length 2.35 mm); body 14 × 14 × 2.2 mm	2 – 61
SOT208-1	QFP64	Plastic quad flat package; 64 leads (lead length 2.35 mm); body 14 × 20 × 2.75 mm	see note
SOT213-1	SO28	Plastic small outline package; 28 leads; body width 8.4 mm	2 – 100
SOT217-1	CDIL28	Ceramic piggy-back dual in-line package; 28 leads; metal seal	see note
SOT222-1	DIP24	Plastic dual in-line package; 24 leads (300 mil)	2 – 33
SOT232-1	SDIP32	Plastic shrink dual in-line package; 32 leads (400 mil)	2 – 82
SOT234-1	SDIP24	Plastic shrink dual in-line package; 24 leads (400 mil)	2 – 81
SOT238-2	PLCC52	Plastic leaded chip carrier; 52 leads	2 – 54
SOT238-3	PLCC52	Plastic leaded chip carrier; 52 leads; pedestal	2 – 55
SOT240-1	DIP48	Plastic dual in-line package; 48 leads (600 mil)	2 – 40
SOT243-1	DBS17P	Plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm)	2 – 19

Note: Although an outline drawing is not given in this databook, it is available on request.

Philips outline code	Package name	Description	Page
SOT243-3	DBS17P	Plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)	2 – 20
SOT245-1	CPGA64	Ceramic pin grid array; 64 pins; face down	see note
SOT247-1	SDIP52	Plastic shrink dual in-line package; 52 leads (600 mil)	2 – 84
SOT248-1	DIP24	Plastic dual in-line package; 24 leads (400 mil)	2 – 34
SOT249-1	CSO16	Ceramic small outline package; 16 leads; large body.	see note
SOT250-1	CSO20	Ceramic small outline package; 20 leads; large body.	see note
SOT251-1	CSO24	Ceramic small outline package; 24 leads; large body.	see note
SOT252-1	CSO28	Ceramic small outline package; 28 leads; large body.	see note
SOT255-1	CLLCC28	Ceramic leadless chip carrier; 28 connecting pads	see note
SOT256-1	CLLCC20	Ceramic leadless chip carrier; 20 connecting pads	see note
SOT257-1	CPGA68	Ceramic pin grid array; 68 pins	see note
SOT258-1	CPGA84	Ceramic pin grid array; 84 pins	see note
SOT259-1	CPGA120	Ceramic pin grid array; 120 pins	see note
SOT260-1	CPGA144	Ceramic pin grid array; 144 pins	see note
SOT261-2	PLCC28	Plastic leaded chip carrier; 28 leads	2 – 50
SOT261-3	PLCC28	Plastic leaded chip carrier; 28 leads; pedestal	2 – 51
SOT265-1	CPGA108	Ceramic pin grid array; 108 pins	see note
SOT266-1	SSOP20	Plastic shrink small outline package; 20 leads; body width 4.4 mm	2 – 106
SOT270-1	SDIP42	Plastic shrink dual in-line package; 42 leads (600 mil)	2 – 83
SOT274-1	SDIP64	Plastic shrink dual in-line package; 64 leads (750 mil)	2 – 85
SOT287-1	SO32	Plastic small outline package; 32 leads; body width 7.5 mm	2 – 101
SOT292-1	CQFP48	Ceramic quad flat package; 48 leads	see note
SOT293-1	CPGA63	Ceramic pin grid array; 63 pins; face down	see note
SOT293-3	CPGA63	Ceramic pin grid array; 63 pins; face down	see note
SOT293-4	CPGA63	Ceramic pin grid array; 63 pins; face down	see note
SOT307-2	QFP44	Plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 × 10 × 1.75 mm	2 – 62
SOT309-1	CPGA44	Ceramic pin grid array; 44 pins	see note

Note: Although an outline drawing is not given in this databook, it is available on request.

Philips outline code	Package name	Description	Page
SOT310-1	QFP80	Plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 × 20 × 3.0 mm	2 – 68
SOT313-1	LQFP48	Plastic low profile quad flat package; 48 leads; body 7 × 7 × 1.4 mm	see note
SOT313-2	LQFP48	Plastic low profile quad flat package; 48 leads; body 7 × 7 × 1.4 mm	2 – 46
SOT314-2	LQFP64	Plastic low profile quad flat package; 64 leads; body 10 × 10 × 1.4 mm	2 – 47
SOT315-1	LQFP80	Plastic low profile quad flat package; 80 leads; body 12 × 12 × 1.4 mm	2 – 48
SOT316-1	SQFP208	Plastic shrink quad flat package; 208 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm	2 – 102
SOT317-1	QFP100	Plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 – 72
SOT317-2	QFP100	Plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 – 73
SOT318-1	QFP80	Plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 – 69
SOT318-2	QFP80	Plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 – 70
SOT318-3	QFP80	Plastic quad flat package; 80 leads (lead length 2.35 mm); body 14 × 20 × 2.8 mm	2 – 71
SOT319-1	QFP64	Plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 – 64
SOT319-2	QFP64	Plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 – 65
SOT319-3	QFP64	Plastic quad flat package; 64 leads (lead length 2.35 mm); body 14 × 20 × 2.8 mm	2 – 66
SOT320-1	QFP128	Plastic quad flat package; 128 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 – 75
SOT322-1	QFP160	Plastic quad flat package; 160 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 – 78
SOT325-1	SDIP20	Plastic shrink dual in-line package; 20 leads (300 mil)	2 – 80
SOT326-1	CLCC44	Ceramic leaded chip carrier; 44 leads	see note
SOT327-1	CLCC68	Ceramic leaded chip carrier; 68 leads	see note
SOT327-2	CLCC68	Ceramic leaded chip carrier; 68 leads	see note
SOT327-3	CLCC68	Ceramic leaded chip carrier; 68 leads	see note

Note: Although an outline drawing is not given in this databook, it is available on request.

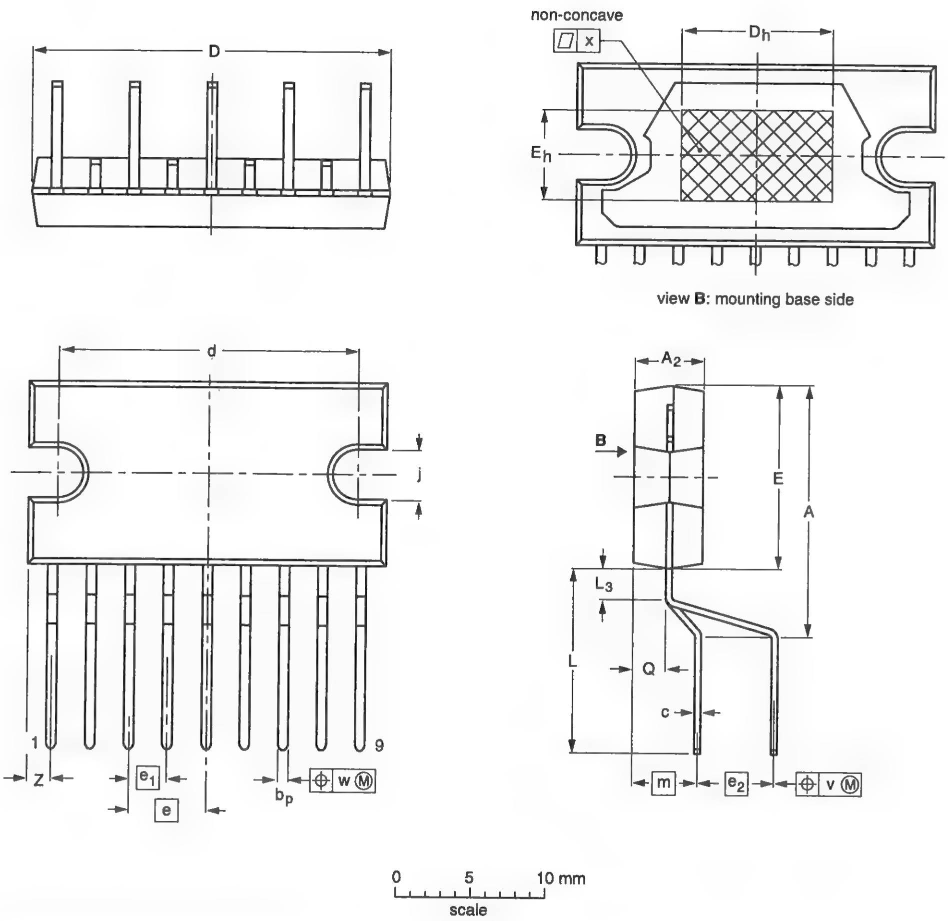
Philips outline code	Package name	Description	Page
SOT328-1	CQFP40	Ceramic quad flat package; 40 leads	see note
SOT329-1	CQFP64	Ceramic quad flat package; 64 leads	see note
SOT335-1	CLCC84	Ceramic leaded chip carrier; 84 leads	see note
SOT337-1	SSOP14	Plastic shrink small outline package; 14 leads; body width 5.3 mm	2 – 103
SOT338-1	SSOP16	Plastic shrink small outline package; 16 leads; body width 5.3 mm	2 – 104
SOT339-1	SSOP20	Plastic shrink small outline package; 20 leads; body width 5.3 mm	2 – 107
SOT340-1	SSOP24	Plastic shrink small outline package; 24 leads; body width 5.3 mm	2 – 108
SOT341-1	SSOP28	Plastic shrink small outline package; 28 leads; body width 5.3 mm	2 – 109
SOT345-1	CQFP32	Ceramic quad flat package; 32 leads	see note
SOT349-1	QFP120	Plastic quad flat package; 120 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 – 76
SOT351-1	CQFP80	Ceramic quad flat package; 80 leads	see note
SOT352-1	RBS9MPF	Plastic rectangular-bent single in-line medium power package with fin; 9 leads	2 – 79
SOT355-1	TSSOP24	Plastic thin shrink small outline package; 24 leads; body width 4.4 mm	2 – 114
SOT356-1	CQFP132	Ceramic quad flat package; 132 leads	see note
SOT357-1	TQFP64	Plastic thin quad flat package; 64 leads; body 10 × 10 × 1.0 mm	see note
SOT358-1	LQFP32	Plastic low profile quad flat package; 32 leads; body 7 × 7 × 1.4 mm	2 – 44
SOT360-1	TSSOP20	Plastic thin shrink small outline package; 20 leads; body width 4.4 mm	2 – 113
SOT361-1	TSSOP28	Plastic thin shrink small outline package; 28 leads; body width 4.4 mm	see note
SOT362-1	TSSOP48	Plastic thin shrink small outline package; 48 leads; body width 6.1 mm	see note
SOT364-1	TSSOP56	Plastic thin shrink small outline package; 56 leads; body width 6.1 mm	see note
SOT369-1	SSOP16	Plastic shrink small outline package; 16 leads; body width 4.4 mm	2 – 105
SOT370-1	SSOP48	Plastic shrink small outline package; 48 leads; body width 7.5 mm	2 – 111
SOT371-1	SSOP56	Plastic shrink small outline package; 56 leads; body width 7.5 mm	2 – 112
SOT375-1	TQFP80	Plastic thin quad flat package; 80 leads; body 12 × 12 × 1.0 mm	see note
SOT376-1	TQFP44	Plastic thin quad flat package; 44 leads; body 10 × 10 × 1.0 mm	see note
SOT378-1	SSOP36	Plastic shrink small outline package; 36 leads; body width 7.5 mm; lead pitch 0.8 mm	2 – 110

Note: Although an outline drawing is not given in this databook, it is available on request.

Philips outline code	Package name	Description	Page
SOT379-1	QFP52	Plastic quad flat package; 52 leads (lead length 1.6 mm); body 10 × 10 × 2.0 mm	2 – 63
SOT380-1	PLCC20	Plastic leaded chip carrier; 20 leads	2 – 49
SOT381-1	PLCC32	Plastic leaded chip carrier; 32 leads	2 – 52
SOT382-1	QFP100	Plastic quad flat package; 100 leads (lead length 1.6 mm); body 14 × 20 × 2.8 mm	2 – 74
SOT383-1	QFP120	Plastic quad flat package; 120 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm	2 – 77
SOT386-1	TQFP100	Plastic thin quad flat package; 100 leads; body 14 × 14 × 1.0 mm	see note
SOT387-1	SQFP128	Plastic shrink quad flat package; 128 leads (lead length 1.6 mm); body 14 × 20 × 2.0 mm	see note
SOT389-1	LQFP44	Plastic low profile quad flat package; 44 leads; body 10 × 10 × 1.4 mm	2 – 45
SOT393-1	QFP64	Plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm	2 – 67
SOT394-1	DIP28	Plastic dual in-line package; 28 leads (300 mil)	2 – 37
SOT395-1	DIP64	Plastic dual in-line package; 64 leads (900 mil)	2 – 42
SOT396-1	DIP50	Plastic dual in-line package; 50 leads (900 mil)	2 – 41
SOT398-1	HDIP18	Plastic heat-dissipating dual in-line package; 18 leads	2 – 43
SOT401-1	LQFP32	Plastic low profile quad flat package; 32 leads; body 5 × 5 × 1.4 mm	see note
SOT402-1	TSSOP14	Plastic thin shrink small outline package; 14 leads; body width 4.4 mm	see note
SOT403-1	TSSOP16	Plastic thin shrink small outline package; 16 leads; body width 4.4 mm	see note

Note: Although an outline drawing is not given in this databook, it is available on request.

DBS9P: plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm) — SOT157-2



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_2	b_p	c	D(1)	d	D_h	E(1)	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	Z(1)
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	5.08	2.54	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	2.00 1.45

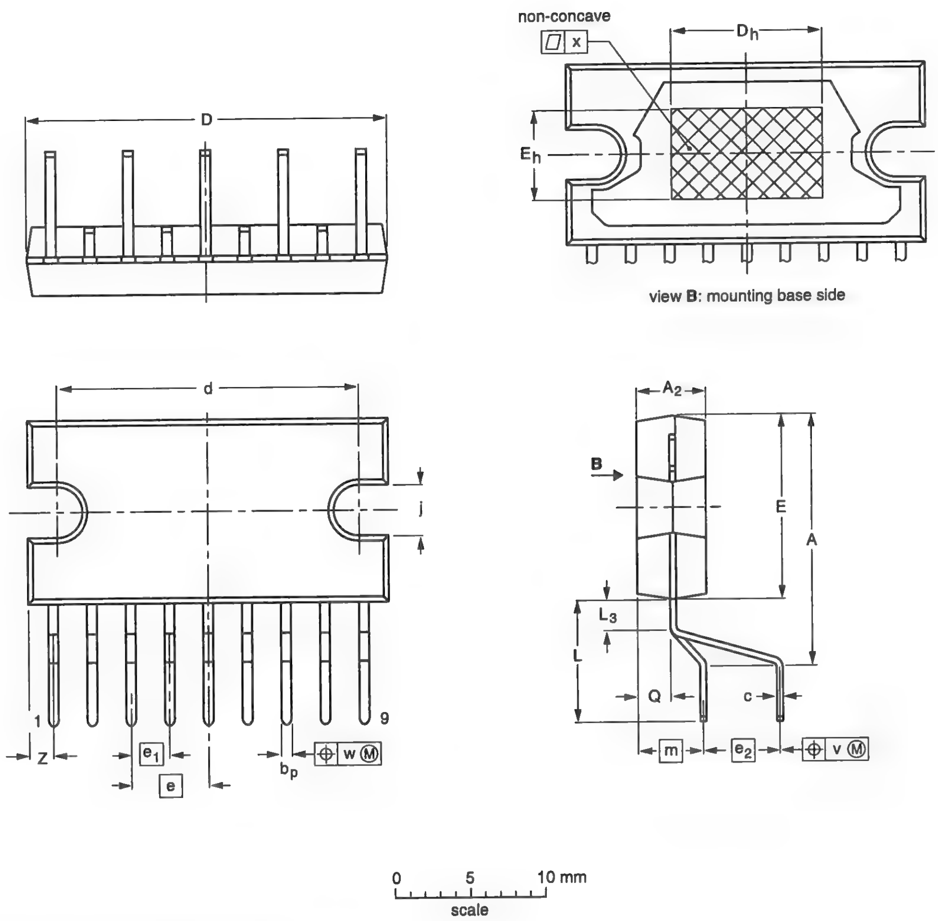
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT157-2						~~92-10-12~~ 95-03-11

DBS9P: plastic DIL-bent-SIL power package; 9 leads (lead length 7.7 mm)

SOT157-4



DIMENSIONS (mm are the original dimensions)

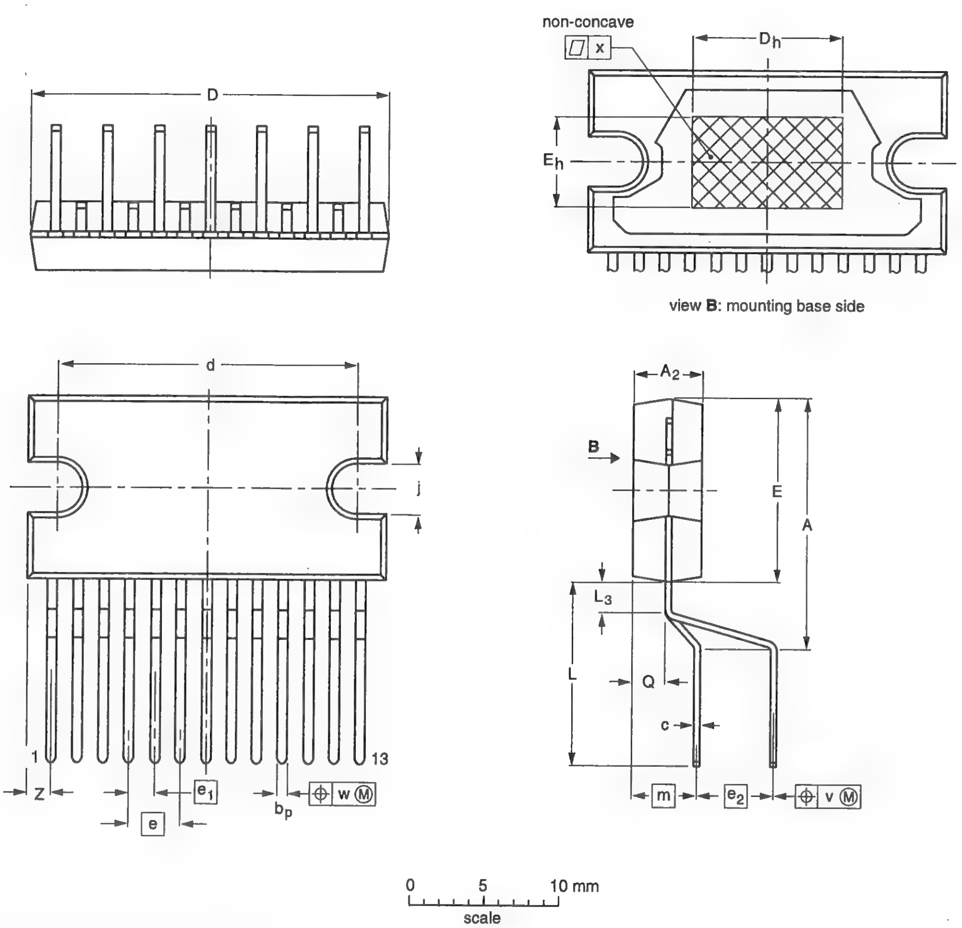
UNIT	A	A_2	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	$Z^{(1)}$
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	5.08	2.54	5.08	6	3.4 3.1	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT157-4						~~92-10-12~~ 95-03-11

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm) **SOT141-6**



DIMENSIONS (mm are the original dimensions)

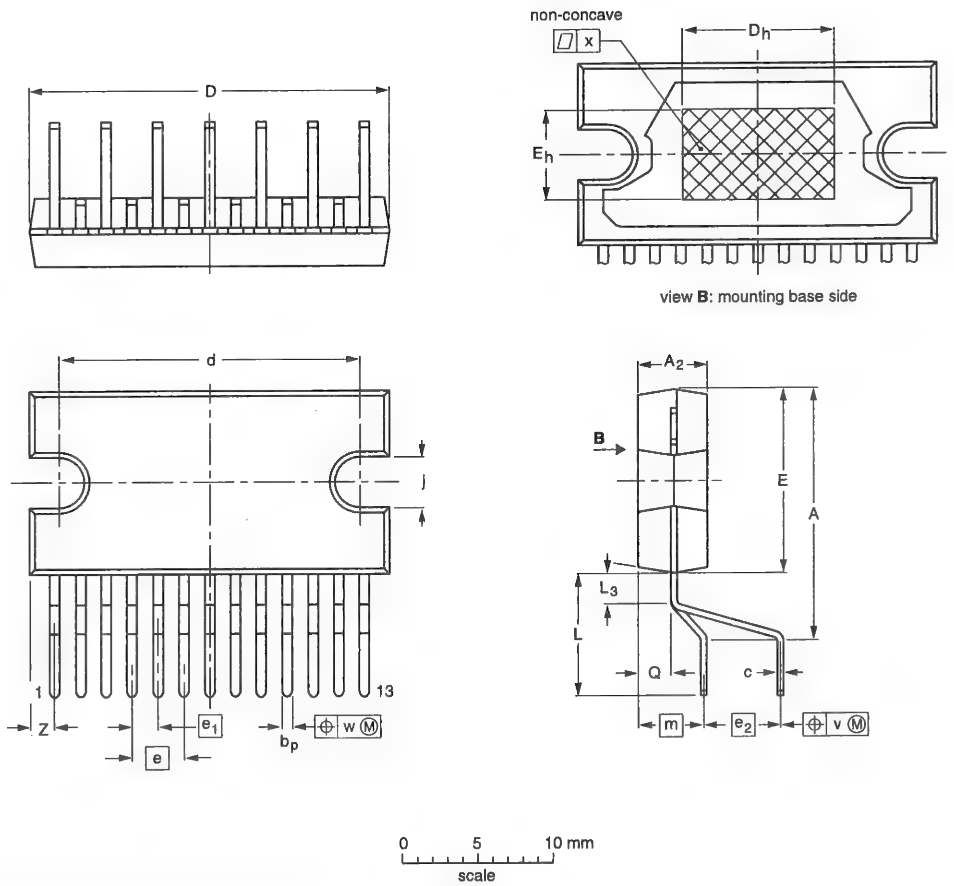
UNIT	A	A_2	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	$Z^{(1)}$
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT141-6						~~92-11-17~~ 95-03-11

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm) SOT141-8



DIMENSIONS (mm are the original dimensions)

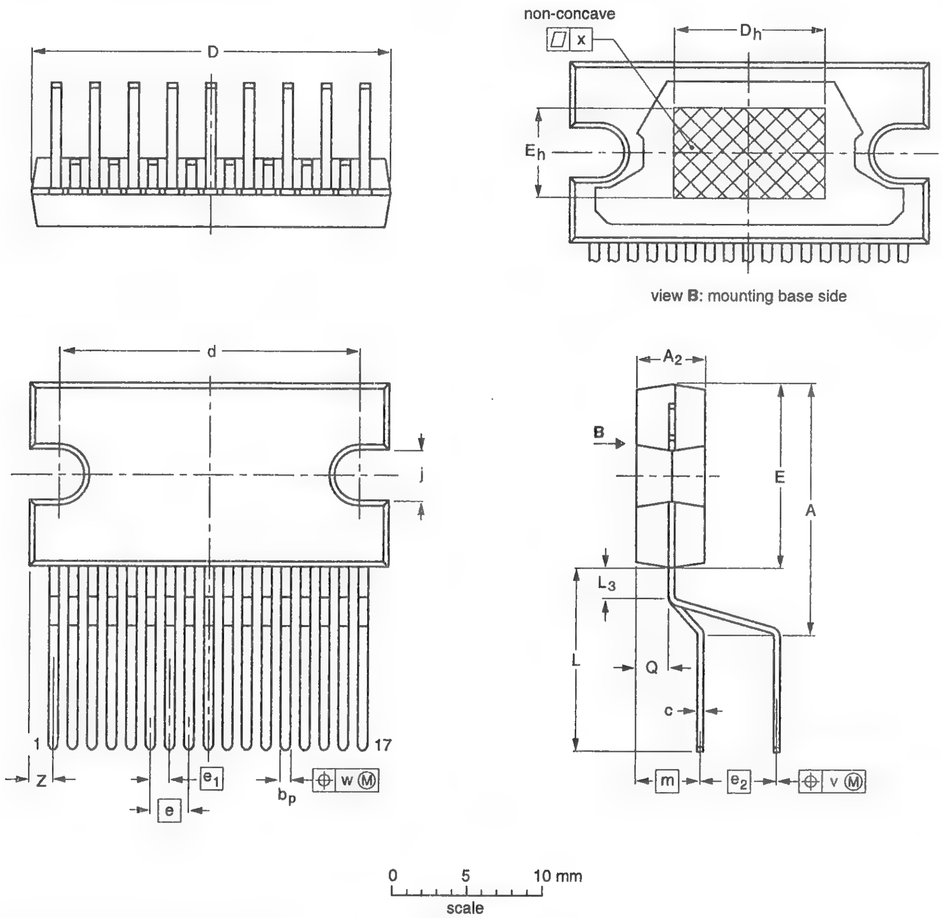
UNIT	A	A_2	b_p	c	D(1)	d	D_h	E(1)	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	Z(1)
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT141-8						~~92-11-17~~ 95-03-11

DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm) SOT243-1



DIMENSIONS (mm are the original dimensions)

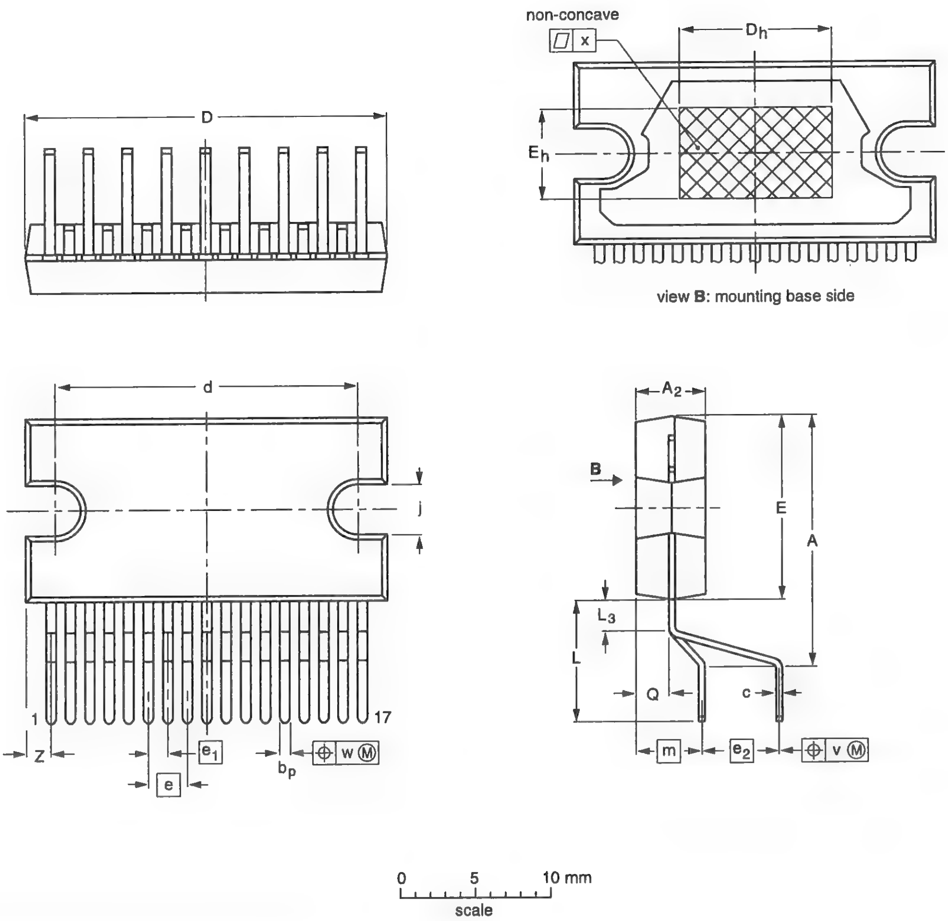
UNIT	A	A_2	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	$Z^{(1)}$
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	1.27	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.4	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT243-1						~~92-11-17~~ 95-03-11

DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm) **SOT243-3**



DIMENSIONS (mm are the original dimensions)

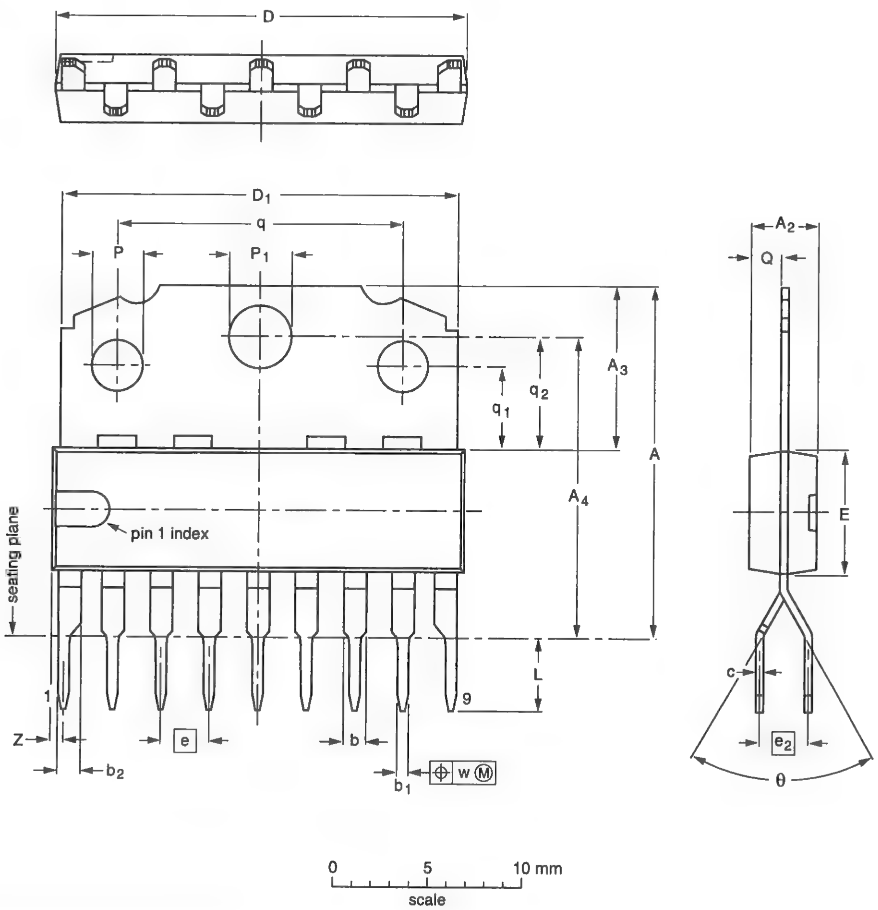
UNIT	A	A_2	b_p	c	D(1)	d	D_h	E(1)	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	Z(1)
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	1.27	5.08	6	3.4 3.1	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT243-3						~~92-11-17~~ 95-03-11

DBS9MPF: plastic DIL-bent-SIL medium power package with fin; 9 leads **SOT111-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_2 max.	A_3	A_4	b	b_1	b_2	c	$D^{(1)}$	D_1	$E^{(1)}$	e	e_2	L	P	P_1	Q	q	q_1	q_2	w	$Z^{(1)}$ max.	θ
mm	18.5 17.8	3.7	8.7 8.0	15.5 15.1	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	2.54	3.9 3.4	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.25	1.0	65° 55°

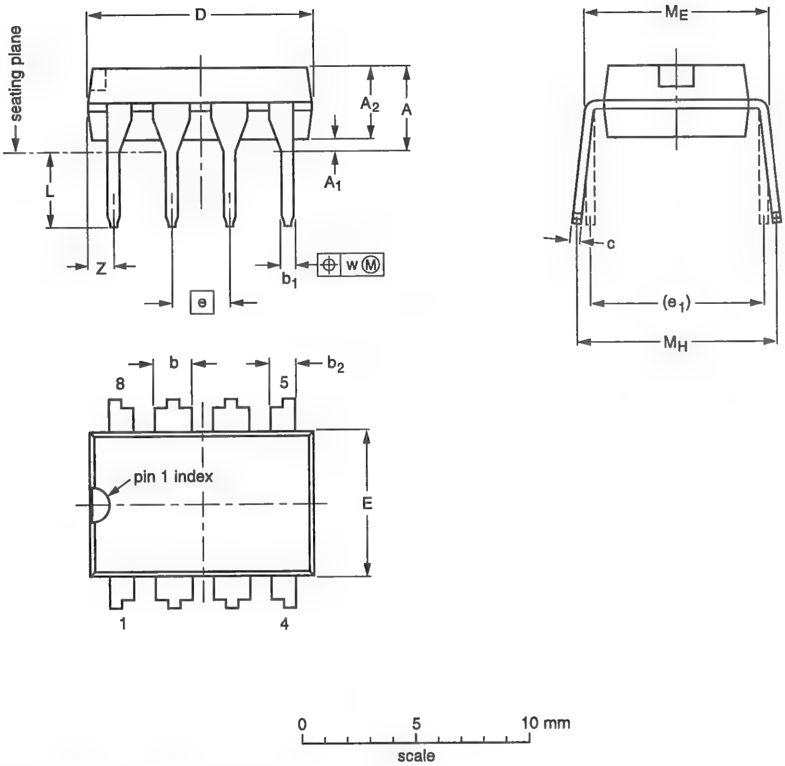
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT111-1						~~92-11-17~~ 95-03-11

DIP8: plastic dual in-line package; 8 leads (300 mil)

SOT97-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.14	0.53 0.38	1.07 0.89	0.36 0.23	9.8 9.2	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	1.15
inches	0.17	0.020	0.13	0.068 0.045	0.021 0.015	0.042 0.035	0.014 0.009	0.39 0.36	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.045

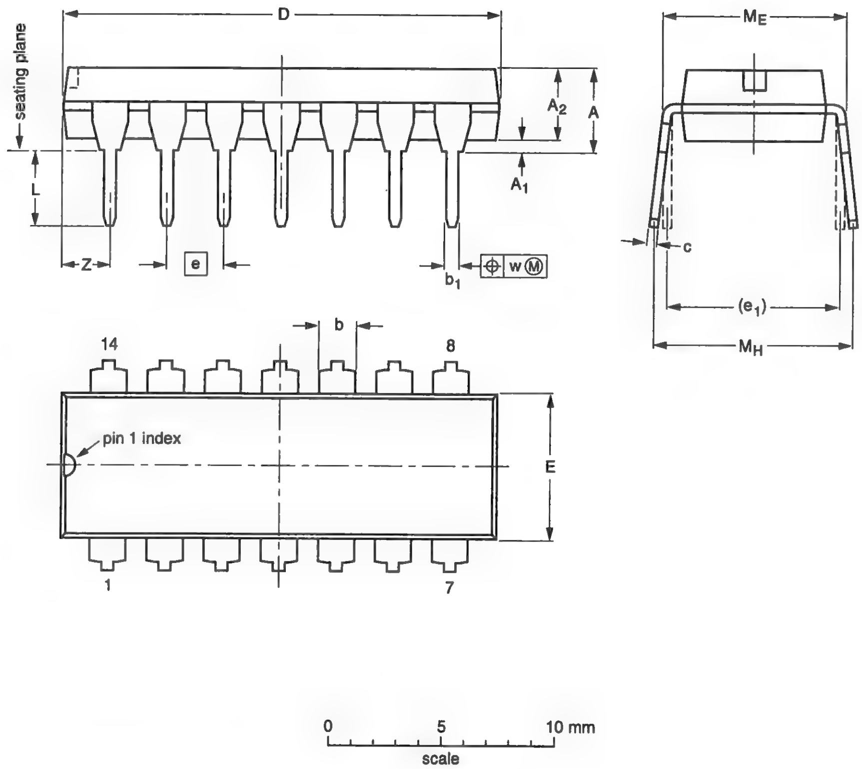
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT97-1	050G01	MO-001AN				~~92-11-17~~ 95-02-04

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

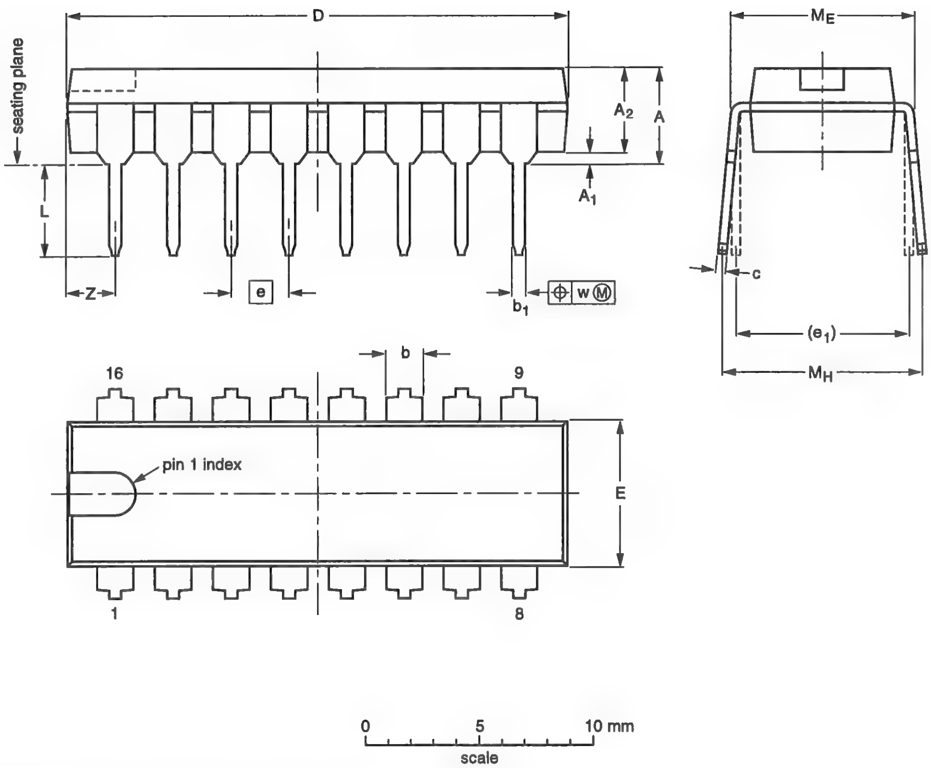
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT27-1	050G04	MO-001AA				~~92-11-17~~ 95-03-11

DIP16: plastic dual in-line package; 16 leads (300 mil); long body **SOT38-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

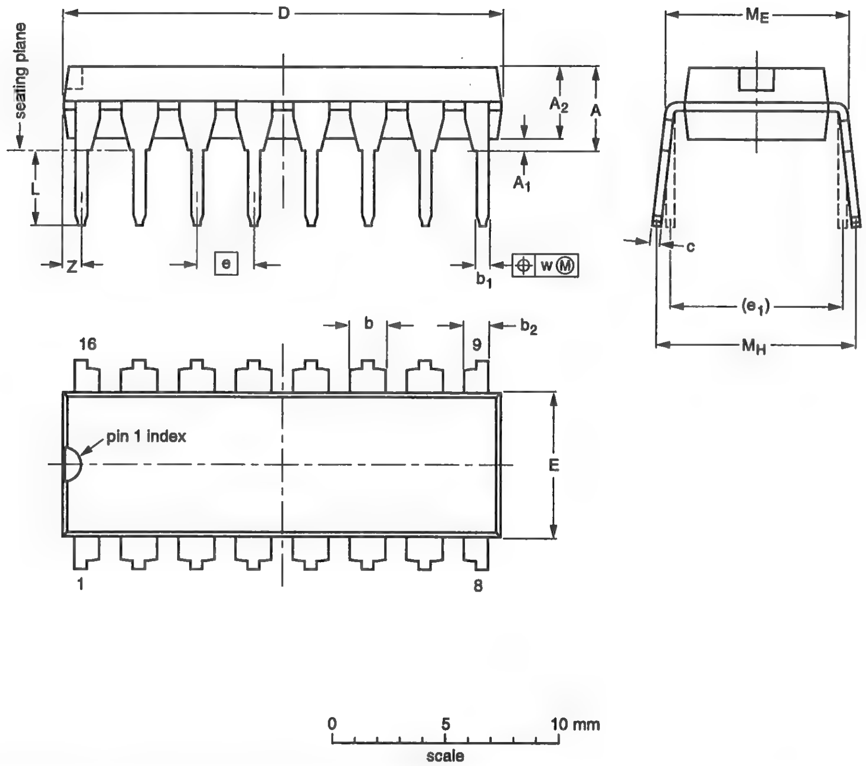
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-1	050G09	MO-001AE				~~92-10-02~~ 95-01-19

DIP16: plastic dual in-line package; 16 leads (300 mil) **SOT38-4**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D(1)	E(1)	e	e_1	L	M_E	M_H	w	Z(1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.030

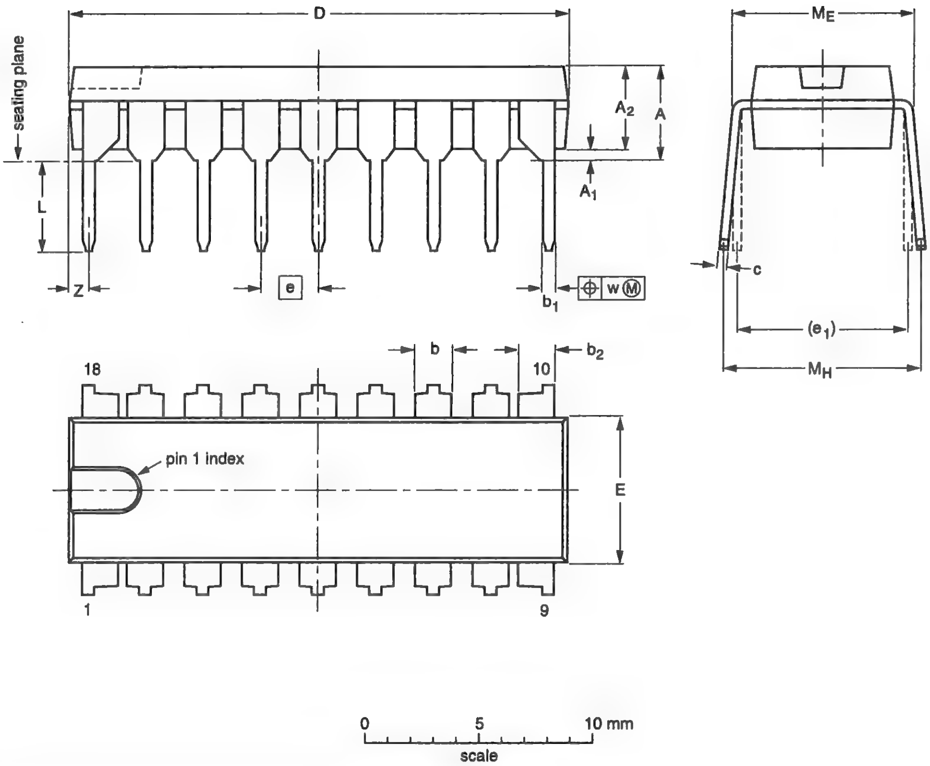
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-4						~~92-11-17~~ 95-01-14

DIP18: plastic dual in-line package; 18 leads (300 mil)

SOT102-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

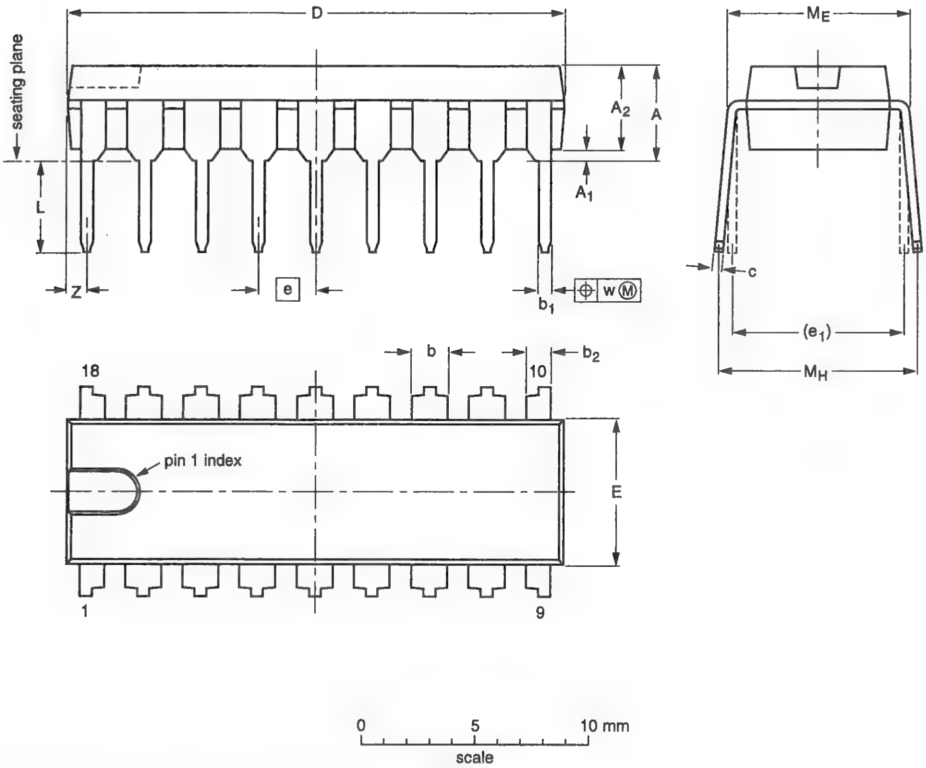
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D(1)	E(1)	e	e_1	L	M_E	M_H	w	Z(1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.40 1.14	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.044	0.021 0.015	0.055 0.044	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT102-1						~~93-10-14~~ 95-01-23

DIP18: plastic dual in-line package; 18 leads (300 mil); slim corner leads **SOT102-2**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

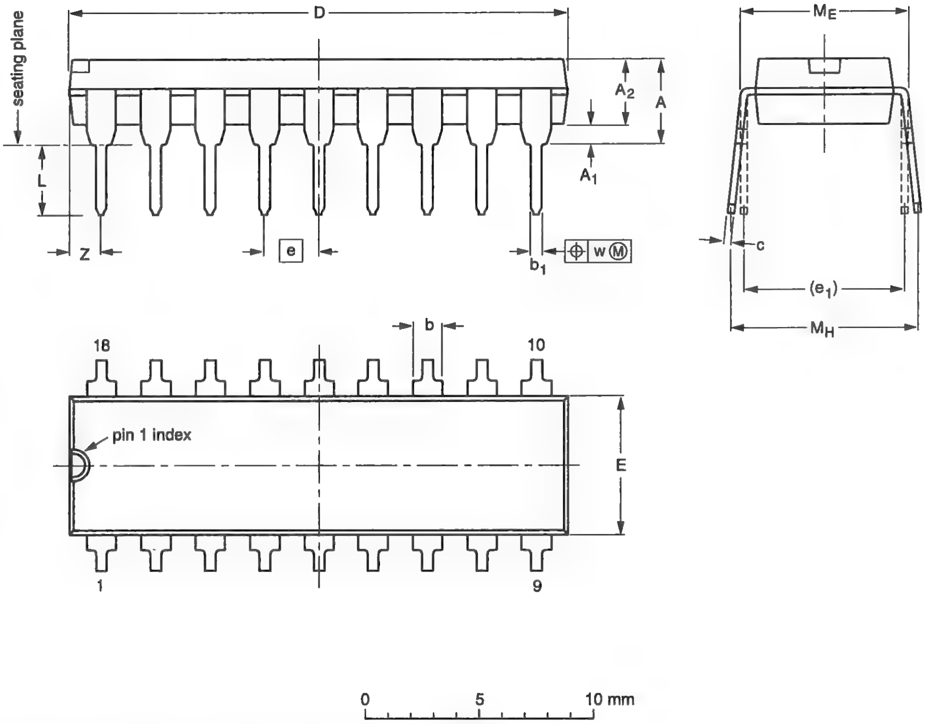
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.05 0.75	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.041 0.030	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT102-2						~~93-10-14~~ 95-01-23

DIP18: plastic dual in-line package; 18 leads (300 mil); long body **SOT102-4**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.06	0.51	3.18	1.63 1.14	0.56 0.43	0.36 0.25	23.50 23.24	6.48 6.22	2.54	7.62	3.51 3.05	8.13 7.62	10.03 7.62	0.25	1.65
inches	0.160	0.020	0.125	0.064 0.045	0.022 0.017	0.014 0.010	0.925 0.915	0.255 0.245	0.100	0.300	0.138 0.120	0.32 0.30	0.395 0.300	0.01	0.065

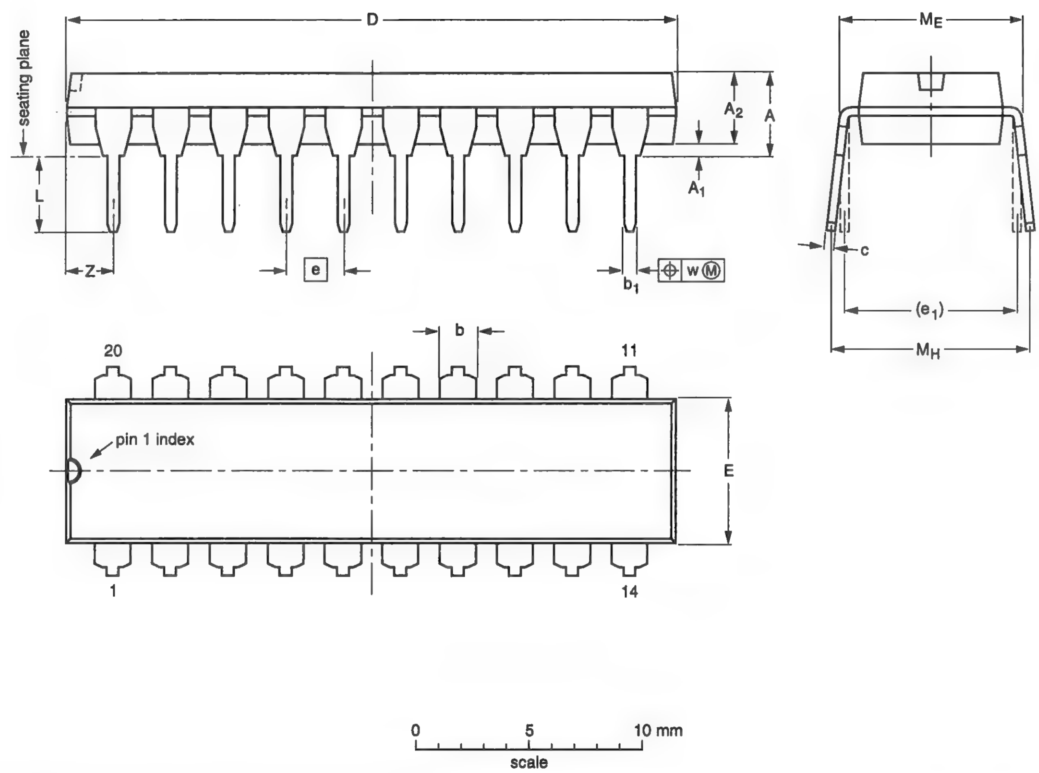
Note

1. Plastic or metal protrusions of 0.01 inch maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT102-4		MS-001AD				95-03-11

DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

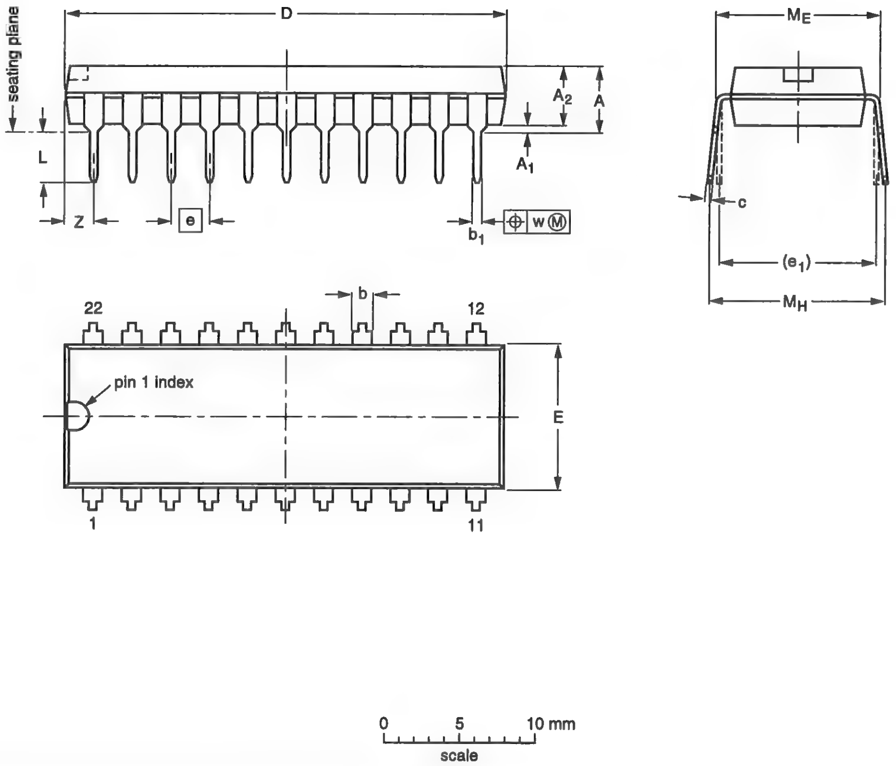
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT146-1			SC603			~~92-11-17~~ 95-03-11

DIP22: plastic dual in-line package; 22 leads (400 mil) **SOT116-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

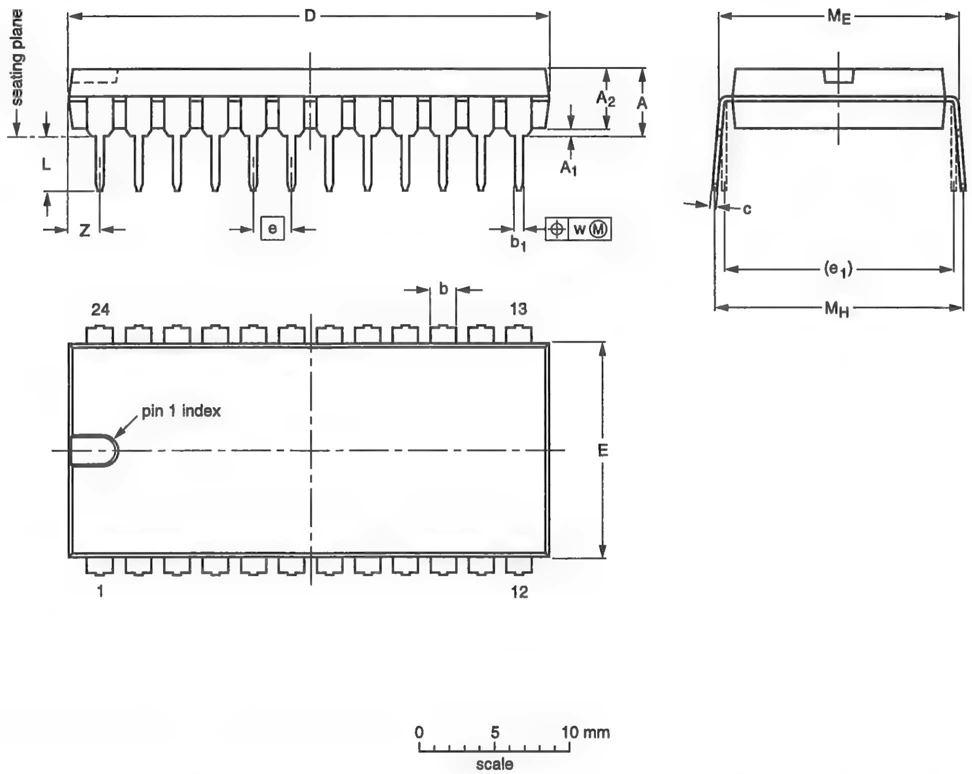
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.83	0.38	3.81	1.65 1.12	0.53 0.38	0.36 0.23	28.19 27.69	9.02 8.38	2.54	10.16	3.60 3.05	10.80 10.16	12.45 10.16	0.254	1.4
inches	0.19	0.015	0.15	0.064 0.044	0.021 0.015	0.014 0.009	1.11 1.09	0.36 0.33	0.10	0.40	0.14 0.12	0.43 0.40	0.49 0.40	0.01	0.055

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT116-1	060G07	MO-026AA				~~92-11-17~~ 95-01-23

DIP24: plastic dual in-line package; 24 leads (600 mil) **SOT101-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

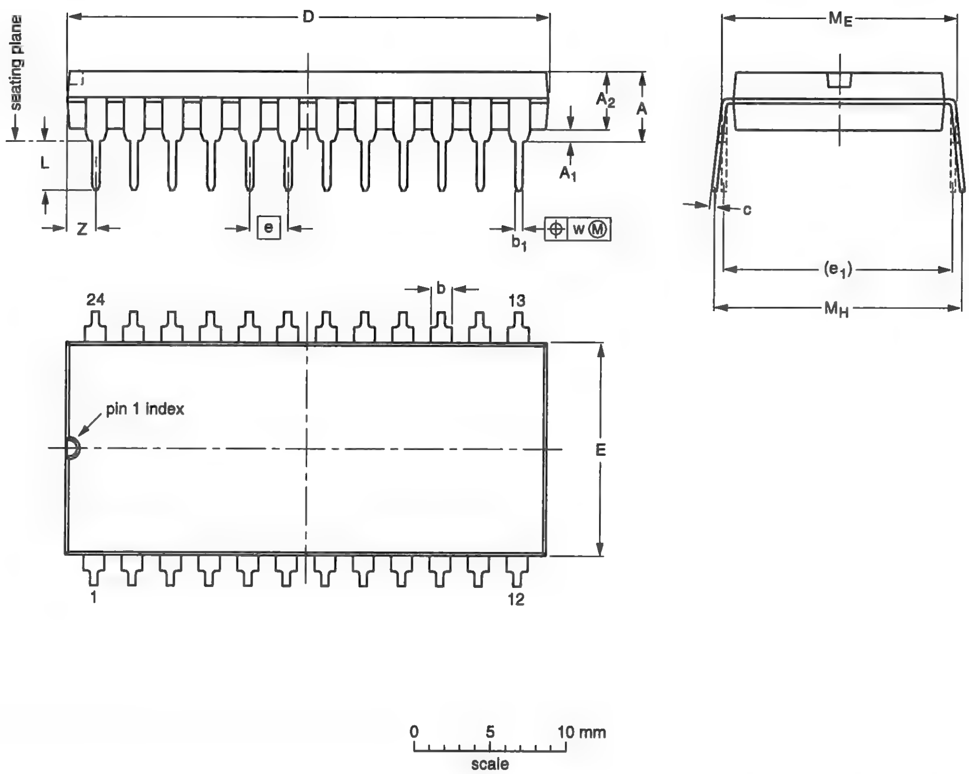
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D [(1)]	E [(1)]	e	e_1	L	M_E	M_H	w	Z [(1)] max.
mm	5.1	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	32.0 31.4	14.1 13.7	2.54	15.24	3.9 3.4	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.20	0.020	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.26 1.24	0.56 0.54	0.10	0.60	0.15 0.13	0.62 0.60	0.68 0.63	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT101-1	051G02	MO-015AD				~~92-11-17~~ 95-01-23

DIP24: plastic dual in-line package; 24 leads (600 mil); short leads **SOT101-2**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

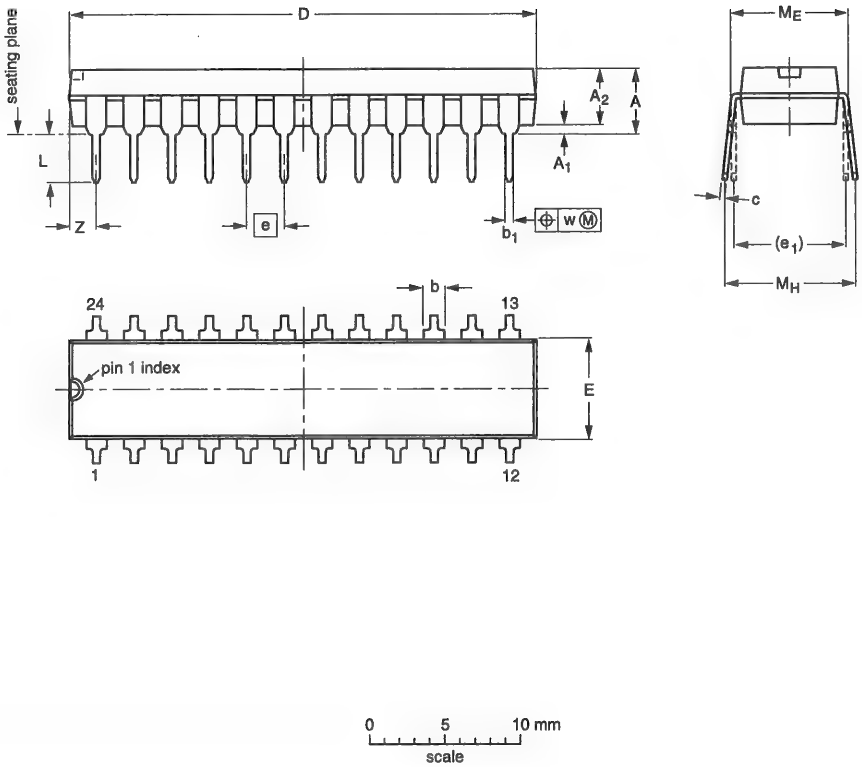
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.08	0.51	3.94	1.63 1.14	0.56 0.43	0.38 0.25	32.0 31.5	14.10 13.84	2.54	15.24	3.51 3.05	15.75 15.24	17.65 15.24	0.25	2.10
inches	0.200	0.020	0.155	0.064 0.045	0.022 0.017	0.015 0.010	1.26 1.24	0.555 0.545	0.100	0.600	0.138 0.120	0.62 0.60	0.695 0.600	0.01	0.083

Note

1. Plastic or metal protrusions of 0.01 inch maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT101-2		MS-011AA				95-03-11

DIP24: plastic dual in-line package; 24 leads (300 mil) **SOT222-1**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

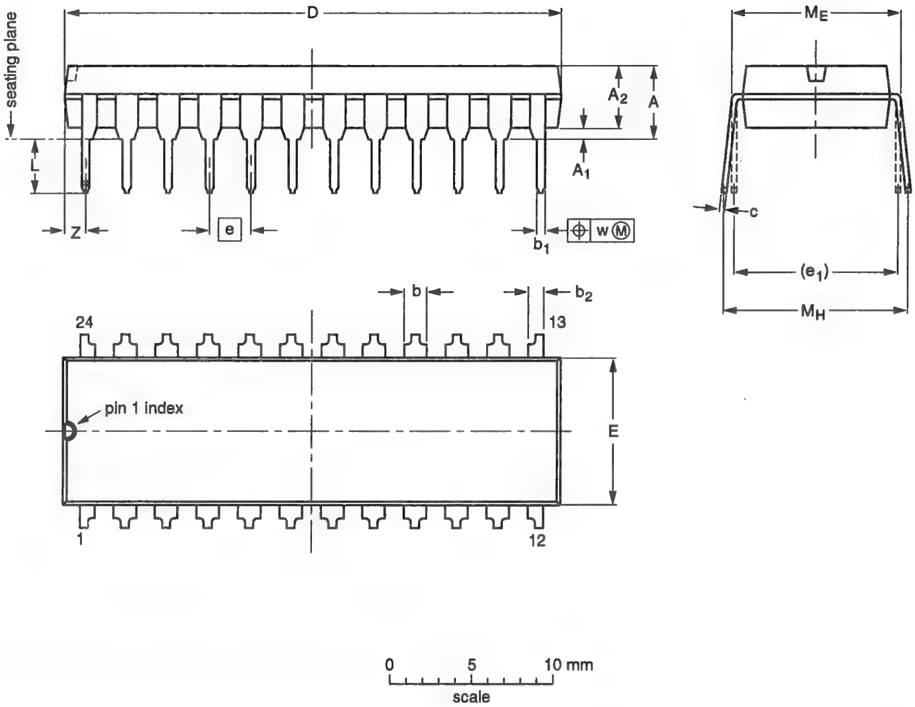
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	4.70	0.38	3.94	1.63 1.14	0.56 0.43	0.36 0.25	31.9 31.5	6.73 6.48	2.54	7.62	3.51 3.05	8.13 7.62	10.03 7.62	0.25	2.05
inches	0.185	0.015	0.155	0.064 0.045	0.022 0.017	0.014 0.010	1.256 1.240	0.265 0.255	0.100	0.300	0.138 0.120	0.32 0.30	0.395 0.300	0.01	0.081

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT222-1		MS-001AF				95-03-11

DIP24: plastic dual in-line package; 24 leads (400 mil); SOT248-1

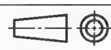


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

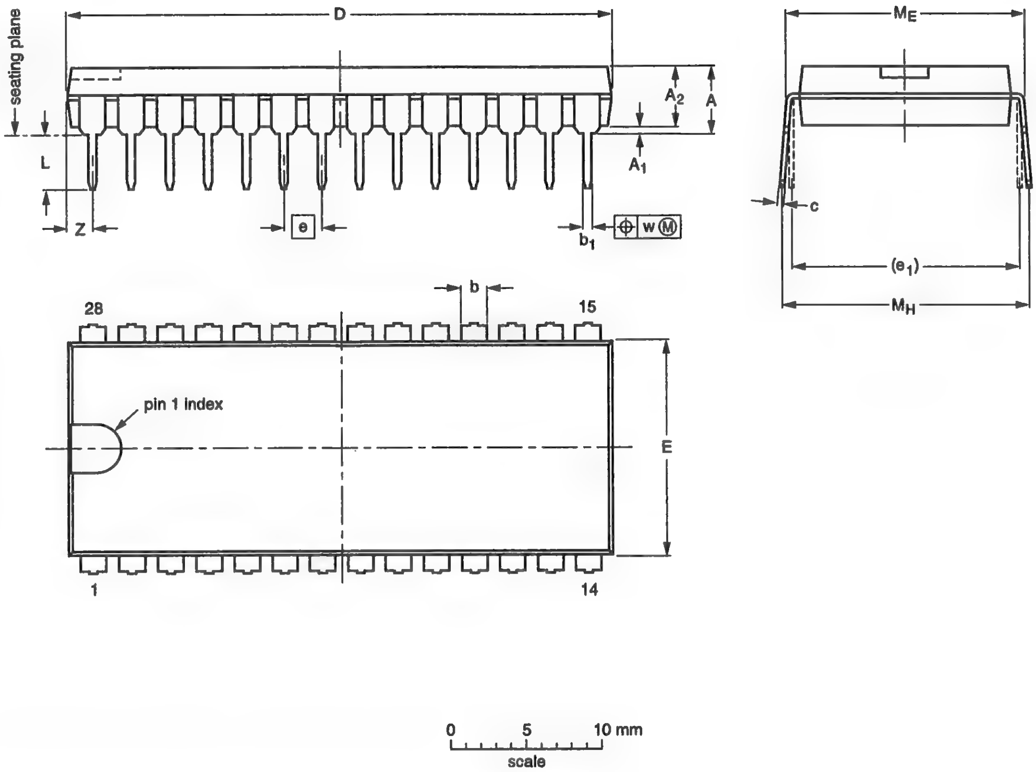
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.83	0.51	3.94	1.63 1.14	0.56 0.43	1.07 0.86	0.36 0.25	30.61 30.23	9.40 8.76	2.54	10.16	3.51 3.05	10.72 10.16	12.57 10.16	0.25	1.40
inches	0.190	0.020	0.155	0.064 0.045	0.022 0.017	0.042 0.034	0.014 0.010	1.205 1.190	0.370 0.345	0.100	0.400	0.138 0.120	0.422 0.400	0.495 0.400	0.01	0.055

Note

1. Plastic or metal protrusions of 0.01 inch maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT248-1						95-03-11

DIP28: plastic dual in-line package; 28 leads (600 mil) **SOT117-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

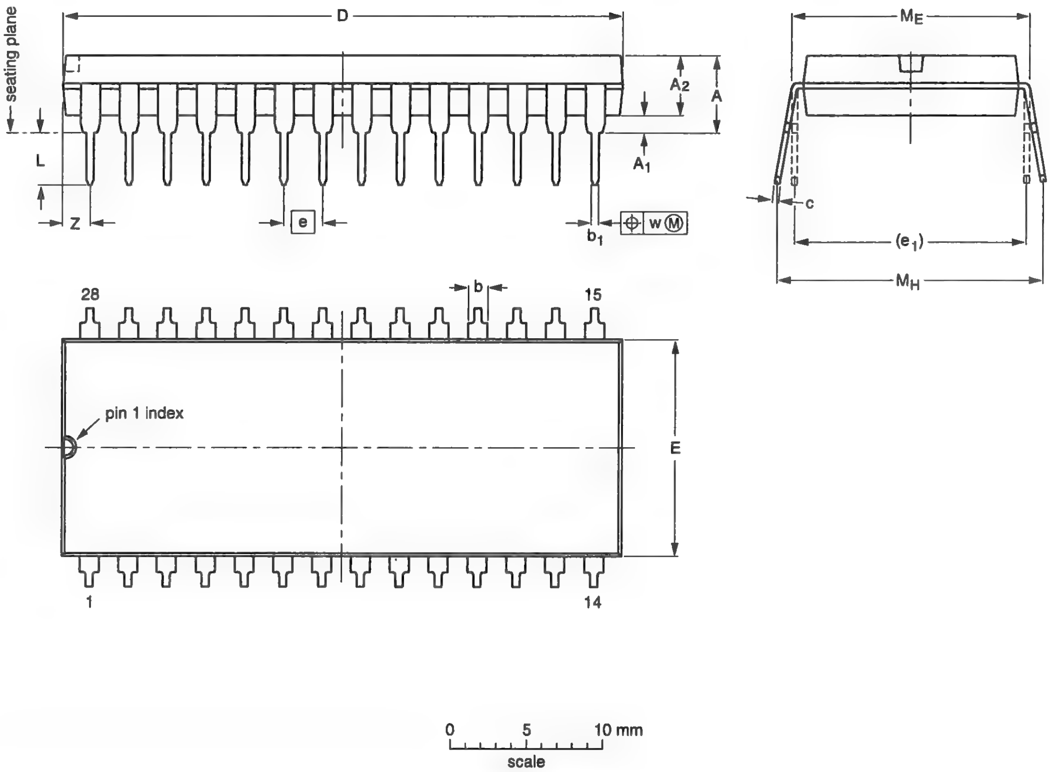
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.1	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	36.0 35.0	14.1 13.7	2.54	15.24	3.9 3.4	15.80 15.24	17.15 15.90	0.25	1.7
inches	0.20	0.020	0.16	0.066 0.051	0.020 0.014	0.013 0.009	1.41 1.34	0.56 0.54	0.10	0.60	0.15 0.13	0.62 0.60	0.68 0.63	0.01	0.067

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT117-1	051G05	MO-015AH				~~92-11-17~~ 95-01-14

DIP28: plastic dual in-line package; 28 leads (600 mil); long body **SOT117-2**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

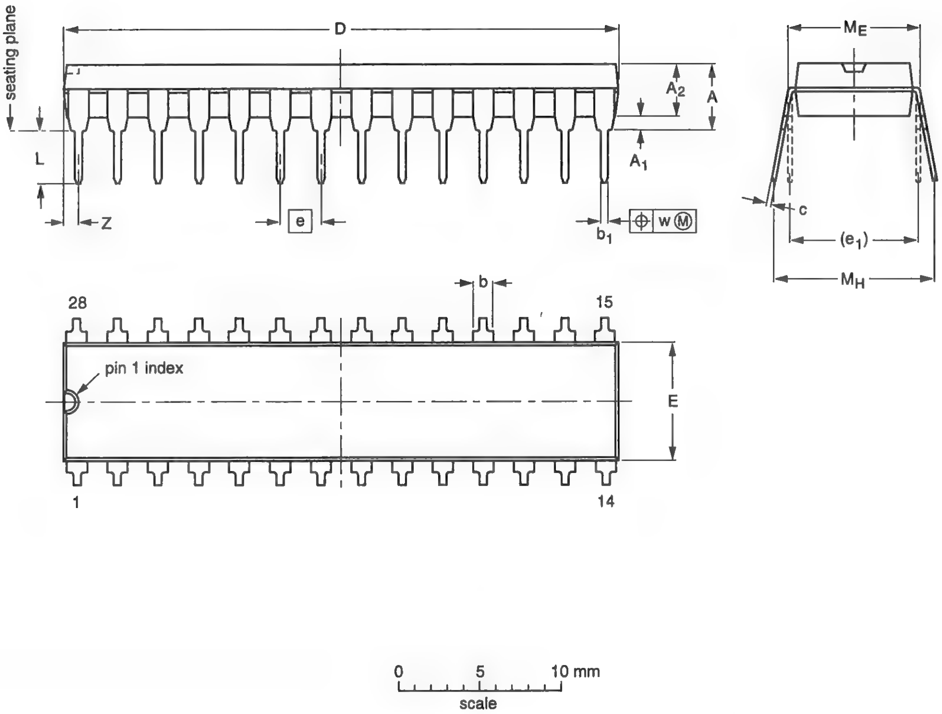
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.08	0.51	3.94	1.63 1.14	0.56 0.43	0.38 0.25	37.08 35.94	14.22 13.84	2.54	15.24	3.51 3.05	15.75 15.24	17.65 15.24	0.25	2.10
inches	0.200	0.020	0.155	0.064 0.045	0.022 0.017	0.015 0.010	1.460 1.415	0.560 0.545	0.100	0.600	0.138 0.120	0.62 0.60	0.695 0.600	0.01	0.083

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT117-2		MS-011AB				95-03-11

DIP28: plastic dual in-line package; 28 leads (300 mil) **SOT394-1**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

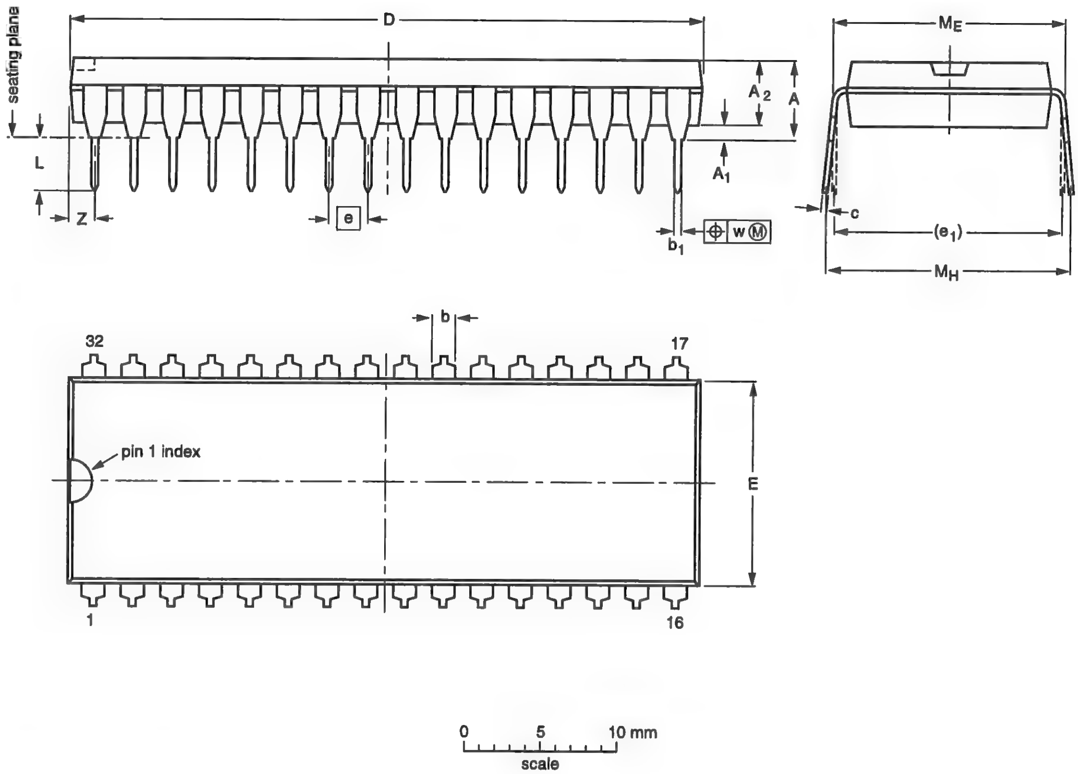
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	5.33	0.25	3.81	1.40 1.14	0.53 0.38	0.36 0.20	35.63 35.38	7.11 6.48	2.54	7.62	3.51 3.05	8.62 7.62	10.03 7.62	0.25	1.67
inches	0.21	0.010	0.15	0.055 0.045	0.021 0.015	0.014 0.008	1.425 1.415	0.280 0.255	0.100	0.300	0.138 0.120	0.325 0.300	0.395 0.300	0.01	0.066

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT394-1						95-03-11

DIP32: plastic dual in-line package; 32 leads (600 mil) **SOT201-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

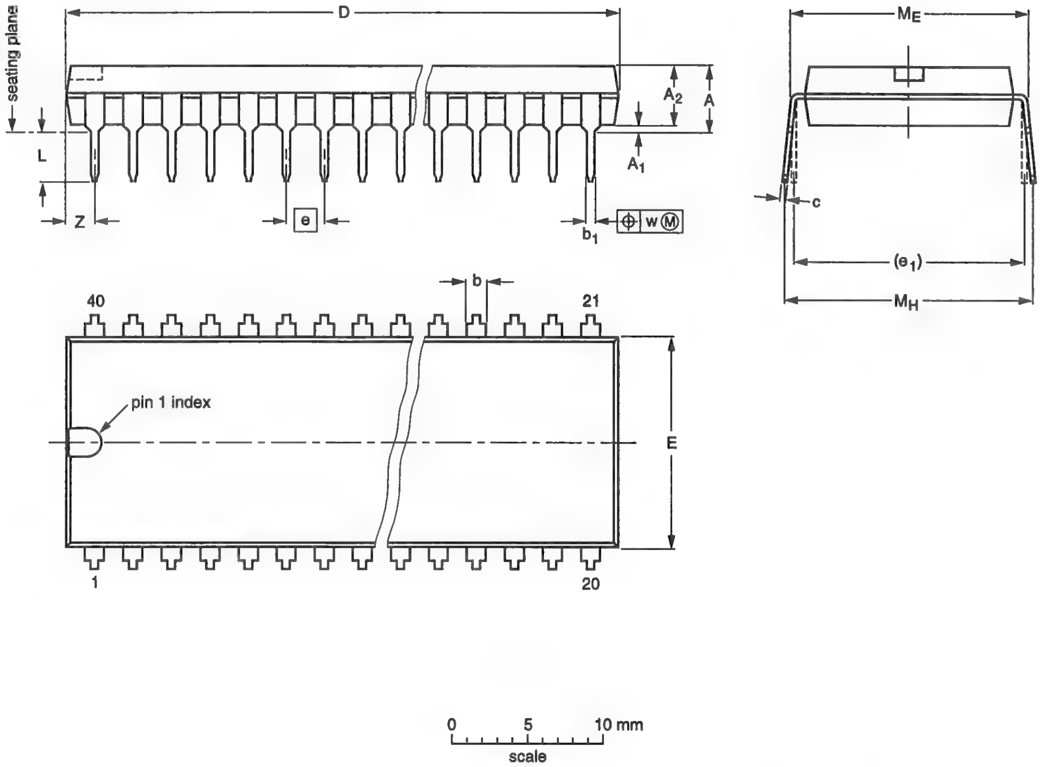
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.0	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	41.6 40.6	14.2 13.8	2.54	15.24	3.6 3.2	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.20	0.020	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.64 1.60	0.56 0.54	0.10	0.60	0.14 0.13	0.62 0.60	0.68 0.63	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT201-1						~~90-01-22~~ 95-01-25

DIP40: plastic dual in-line package; 40 leads (600 mil) SOT129-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	4.0	1.70 1.14	0.53 0.38	0.36 0.23	52.50 51.50	14.1 13.7	2.54	15.24	3.60 3.05	15.80 15.24	17.42 15.90	0.254	2.25
inches	0.19	0.020	0.16	0.067 0.045	0.021 0.015	0.014 0.009	2.067 2.028	0.56 0.54	0.10	0.60	0.14 0.12	0.62 0.60	0.69 0.63	0.01	0.089

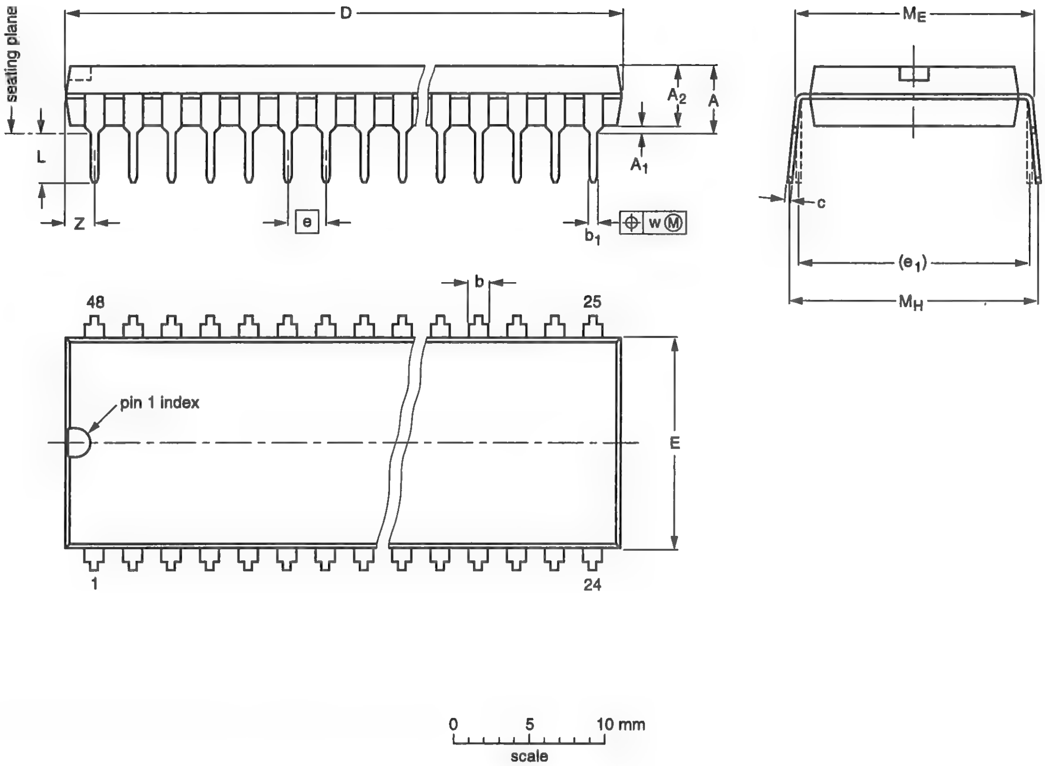
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT129-1	051G08	MO-015AJ				~~92-11-17~~ 95-01-14

DIP48: plastic dual in-line package; 48 leads (600 mil)

SOT240-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

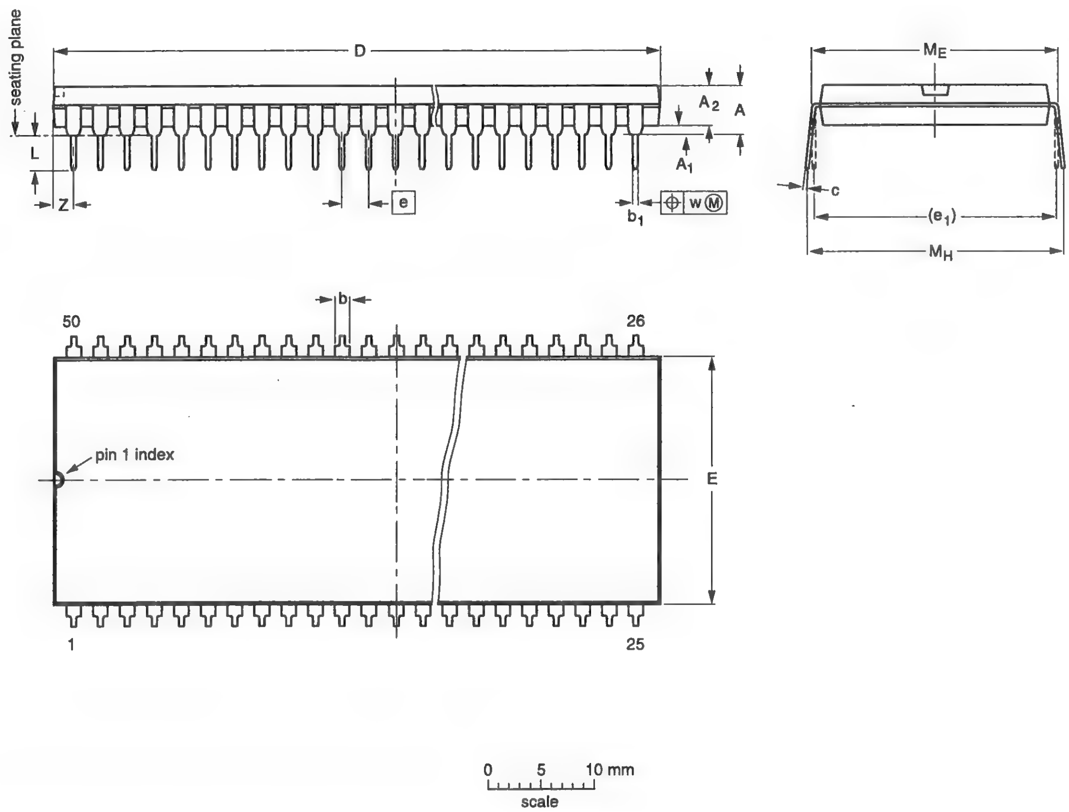
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D[(1)]	E[(1)]	e	e_1	L	M_E	M_H	w	Z[(1)] max.
mm	4.9	0.36	4.06	1.4 1.14	0.53 0.38	0.36 0.23	62.60 61.60	14.22 13.56	2.54	15.24	3.90 3.05	15.88 15.24	18.46 15.24	0.254	2.1
inches	0.19	0.014	0.16	0.055 0.045	0.021 0.015	0.014 0.009	2.46 2.42	0.56 0.53	0.10	0.60	0.15 0.12	0.63 0.60	0.73 0.60	0.01	0.083

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT240-1						~~92-11-17~~ 95-01-25

DIP50: plastic shrink dual in-line package; 50 leads (900 mil) SOT396-1



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

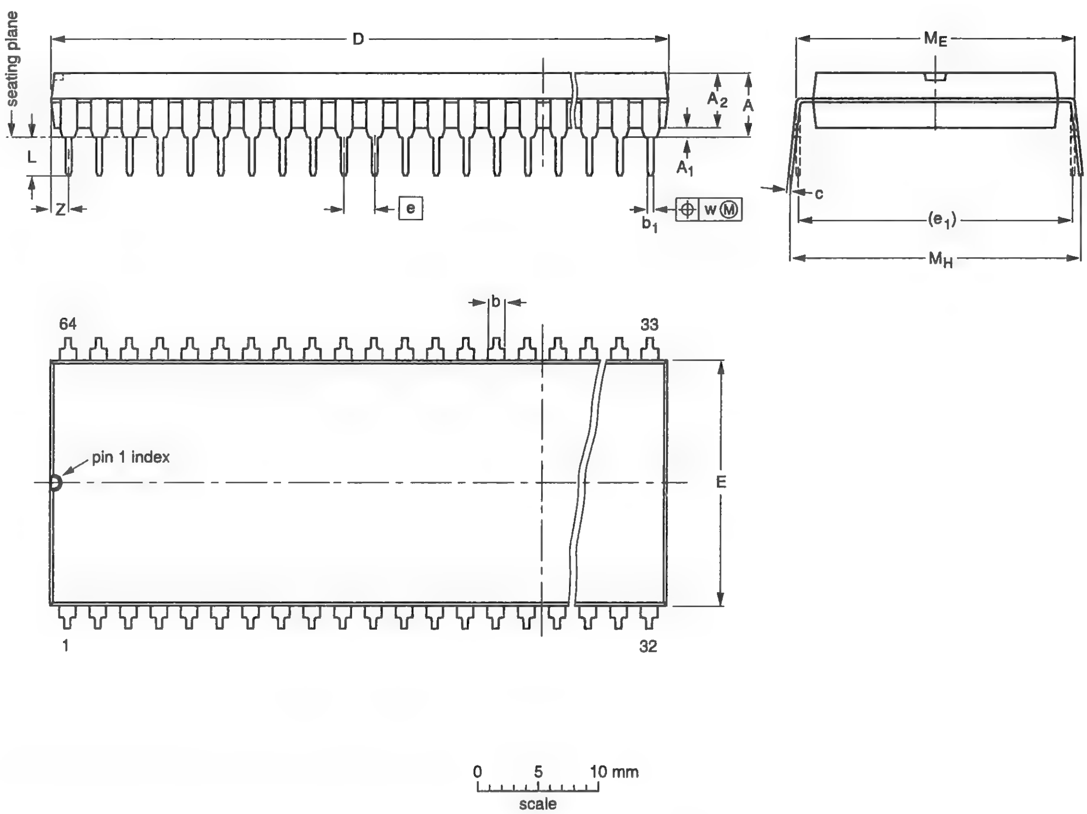
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.08	0.51	3.94	1.63 1.14	0.56 0.38	0.38 0.25	63.88 63.37	21.84 21.46	2.54	22.86	3.43 2.92	23.37 22.61	25.27 22.86	0.25	1.55
inches	0.200	0.020	0.155	0.064 0.045	0.022 0.015	0.015 0.010	2.515 2.495	0.860 0.845	0.100	0.900	0.135 0.115	0.92 0.89	0.995 0.900	0.01	0.061

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT396-1						95-03-11

DIP64: plastic shrink dual in-line package; 64 leads (900 mil) **SOT395-1**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	5.84	0.38	4.70	1.65 1.14	0.56 0.38	0.38 0.25	81.92 81.41	20.57 20.19	2.54	22.86	3.43 2.92	23.50 22.61	25.27 22.86	0.25	1.65
inches	0.23	0.015	0.185	0.065 0.045	0.022 0.015	0.015 0.010	3.225 3.205	0.810 0.795	0.100	0.900	0.135 0.115	0.925 0.890	0.995 0.900	0.01	0.065

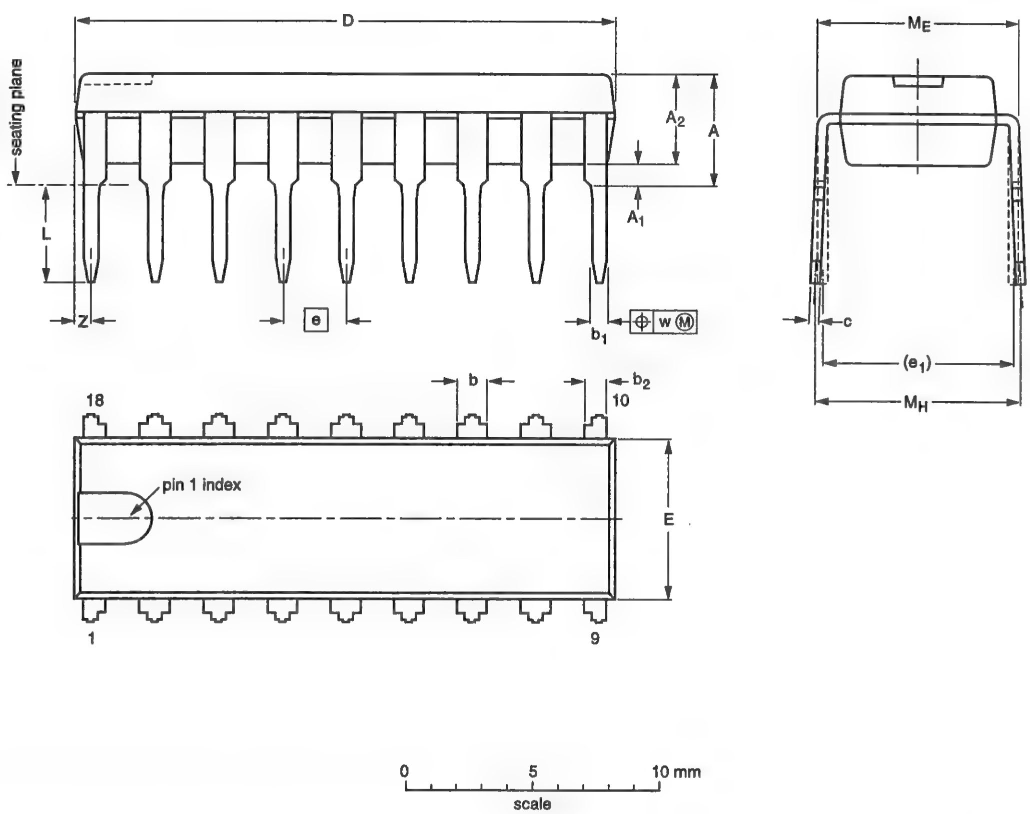
Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT395-1						95-03-11

HDIP18: plastic heat-dissipating dual in-line package; 18 leads

SOT398-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

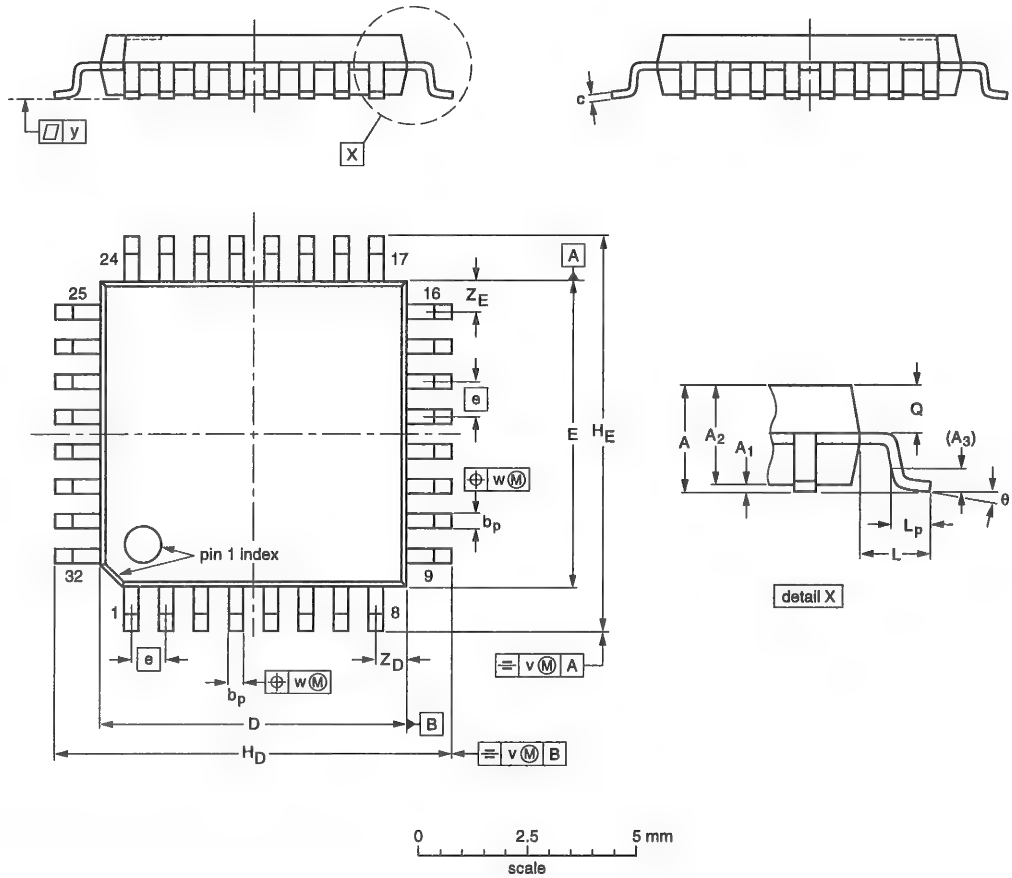
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D[(1)]	E[(1)]	e	e_1	L	M_E	M_H	w	Z[(1)] max.
mm	4.7	0.51	3.7	1.40 1.14	0.67 0.50	1.05 0.75	0.47 0.38	21.85 21.35	6.5 6.2	2.54	7.62	3.9 3.1	8.32 8.02	8.7 7.7	0.25	1.0
inches	0.19	0.02	0.15	0.06 0.04	0.03 0.02	0.04 0.03	0.02 0.01	0.87 0.84	0.26 0.24	0.10	0.30	0.15 0.12	0.33 0.32	0.34 0.30	0.01	0.04

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT398-1						~~94-04-13~~ 95-01-25

LQFP32: plastic low profile quad flat package; 32 leads; body 7 x 7 x 1.4 mm **SOT358-1**



DIMENSIONS (mm are the original dimensions)

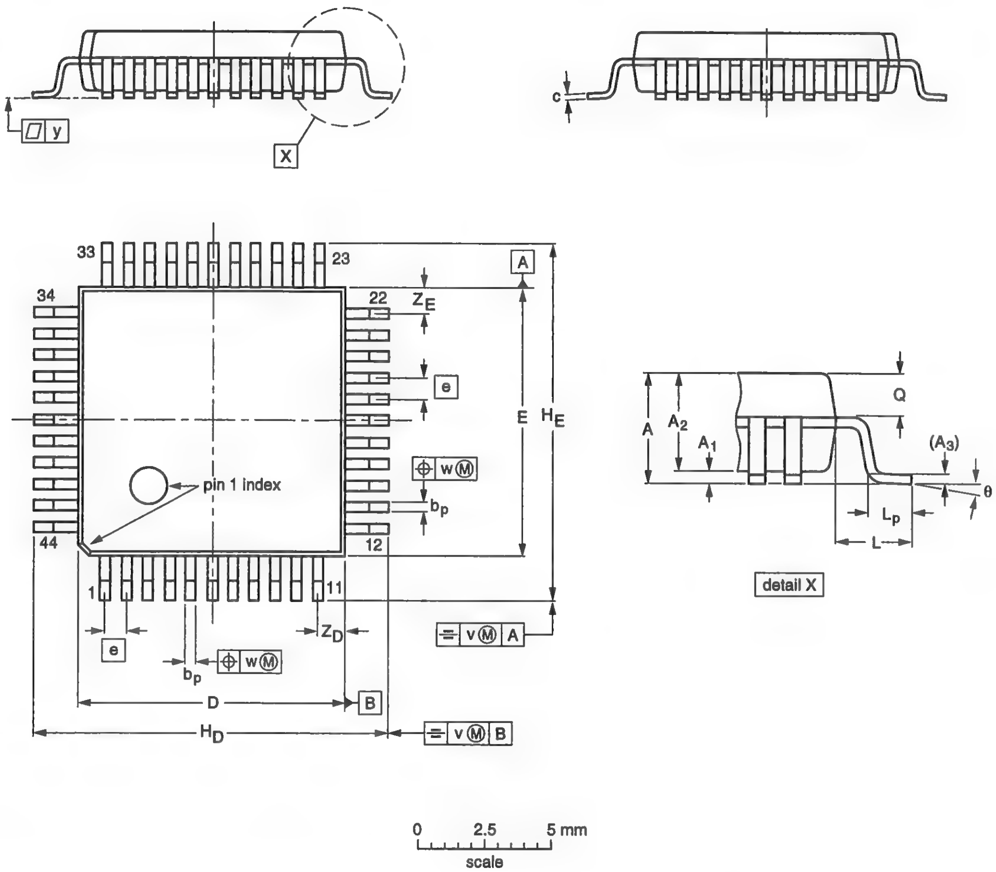
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.4 0.3	0.18 0.12	7.1 6.9	7.1 6.9	0.8	9.15 8.85	9.15 8.85	1.0	0.75 0.45	0.69 0.59	0.2	0.25	0.1	0.9 0.5	0.9 0.5	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT358 -1						~~93-06-29~~ 95-02-25

LQFP44: plastic low profile quad flat package; 44 leads; body 10 x 10 x 1.4 mm **SOT389-1**



DIMENSIONS (mm are the original dimensions)

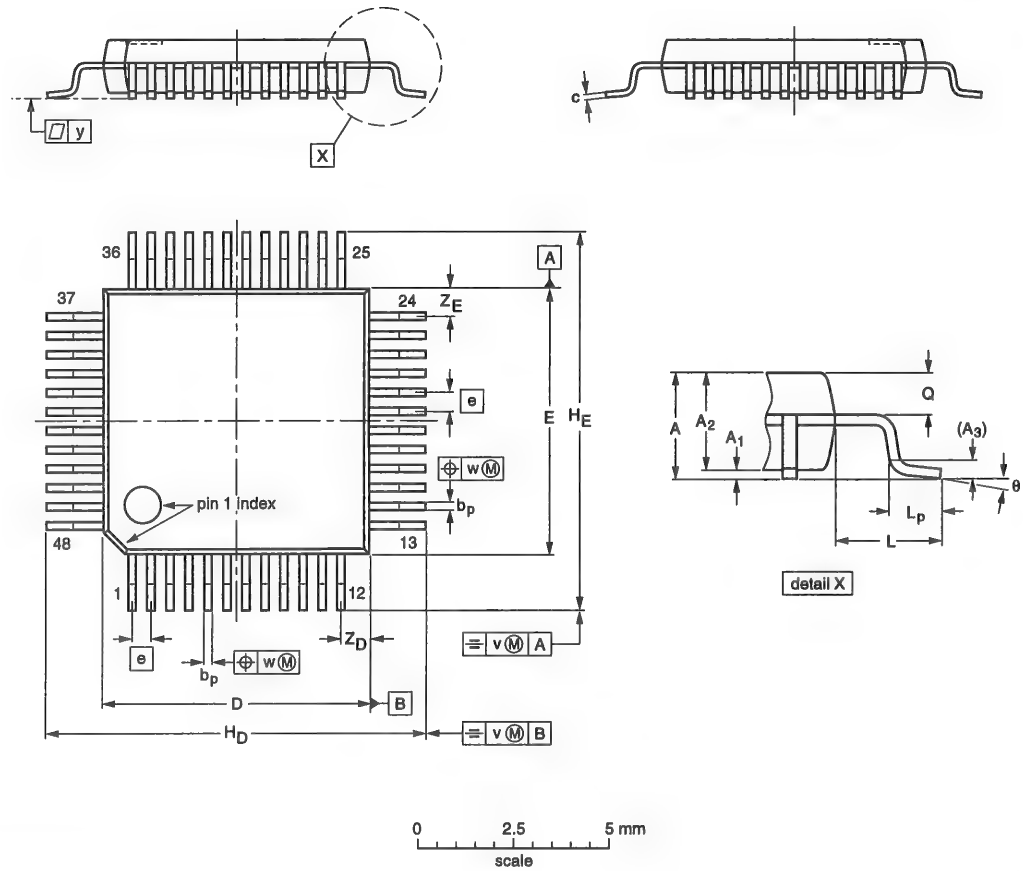
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_D	H_E	L	L_p	Q	v	w	y	Z_D(1)	Z_E(1)	θ
mm	1.60	0.15 0.05	1.45 1.35	0.25	0.45 0.30	0.20 0.12	10.10 9.90	10.10 9.90	0.80	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.70 0.57	0.20	0.20	0.10	1.14 0.85	1.14 0.85	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT389-1						95-02-25

LQFP48: plastic low profile quad flat package; 48 leads; body 7 x 7 x 1.4 mm **SOT313-2**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.27 0.17	0.18 0.12	7.1 6.9	7.1 6.9	0.5	9.15 8.85	9.15 8.85	1.0	0.75 0.45	0.69 0.59	0.2	0.12	0.1	0.95 0.55	0.95 0.55	7° 0°

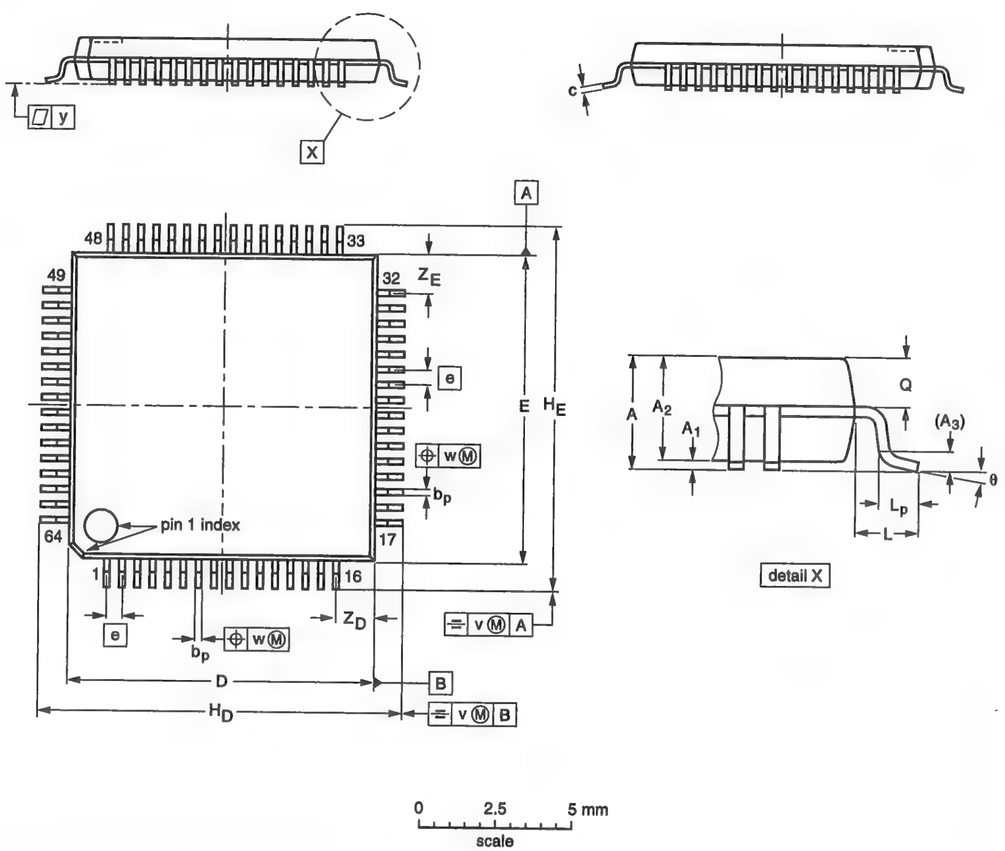
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT313-2						~~93-06-15~~ 94-02-25

LQFP64: plastic low profile quad flat package; 64 leads; body 10 x 10 x 1.4 mm

SOT314-2



DIMENSIONS (mm are the original dimensions)

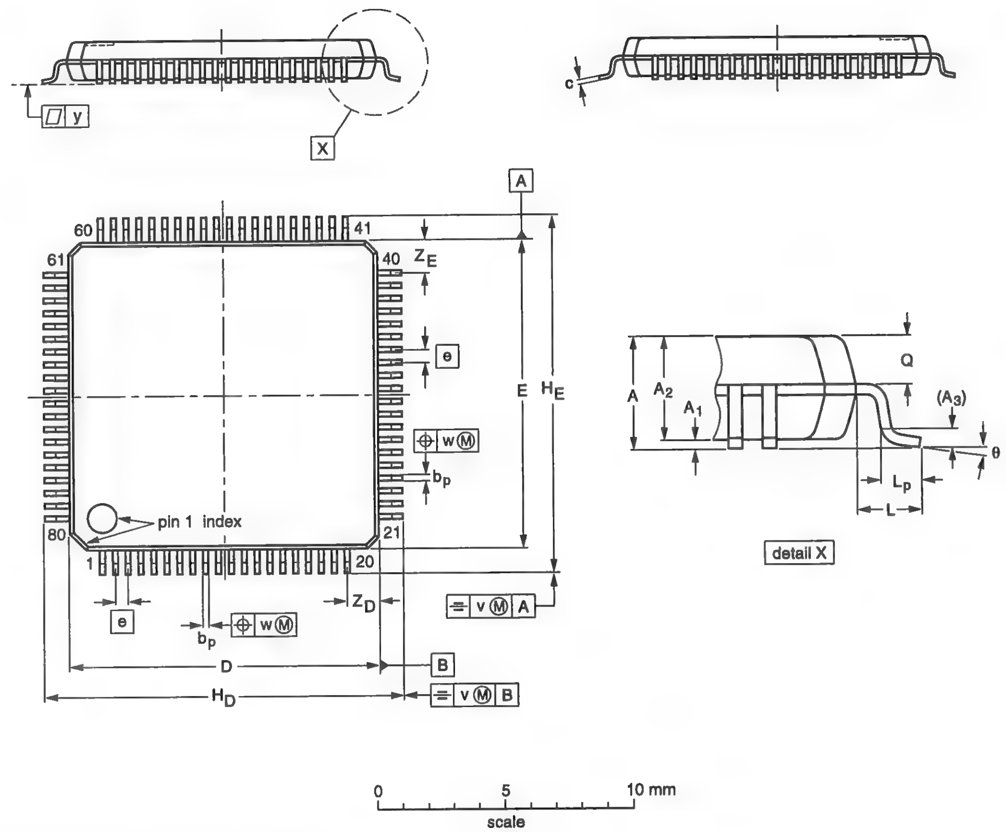
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.27 0.17	0.18 0.12	10.1 9.9	10.1 9.9	0.5	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.69 0.59	0.2	0.12	0.1	1.45 1.05	1.45 1.05	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT314-2						~~94-01-07~~ 95-02-25

LQFP80: plastic low profile quad flat package; 80 leads; body 12 x 12 x 1.4 mm **SOT315-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.6	0.16 0.04	1.5 1.3	0.25	0.25 0.13	0.18 0.12	12.1 11.9	12.1 11.9	0.5	14.15 13.85	14.15 13.85	1.0	0.7 0.3	0.70 0.58	0.2	0.15	0.1	1.45 1.05	1.45 1.05	4° 0°

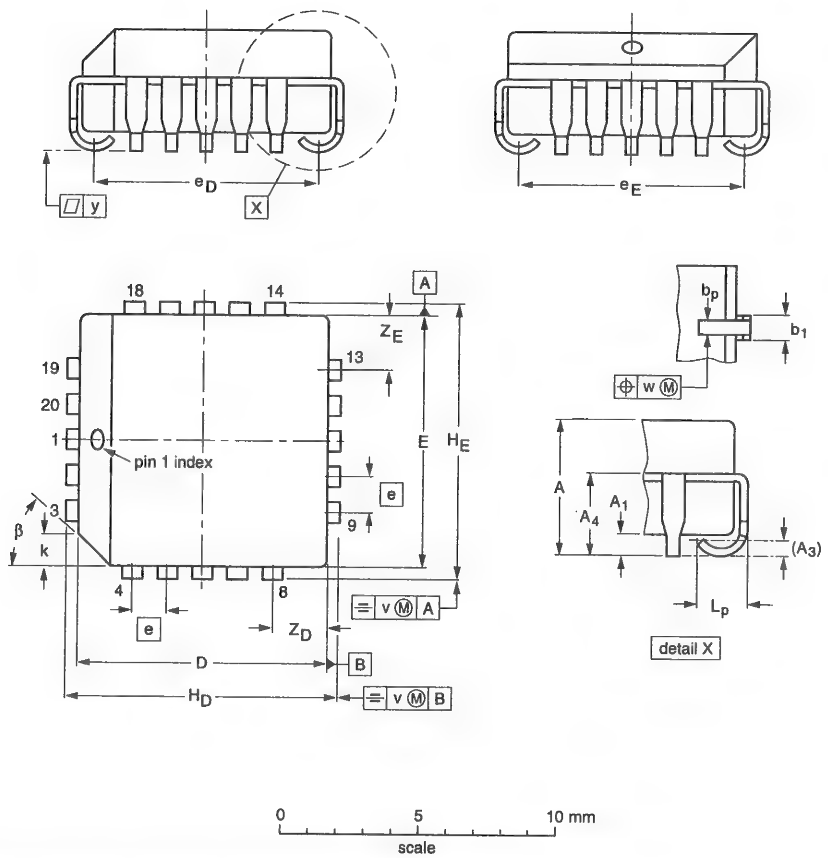
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT315-1						~~92-03-24~~ 95-02-25

PLCC20: plastic leaded chip carrier; 20 leads

SOT380-1



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

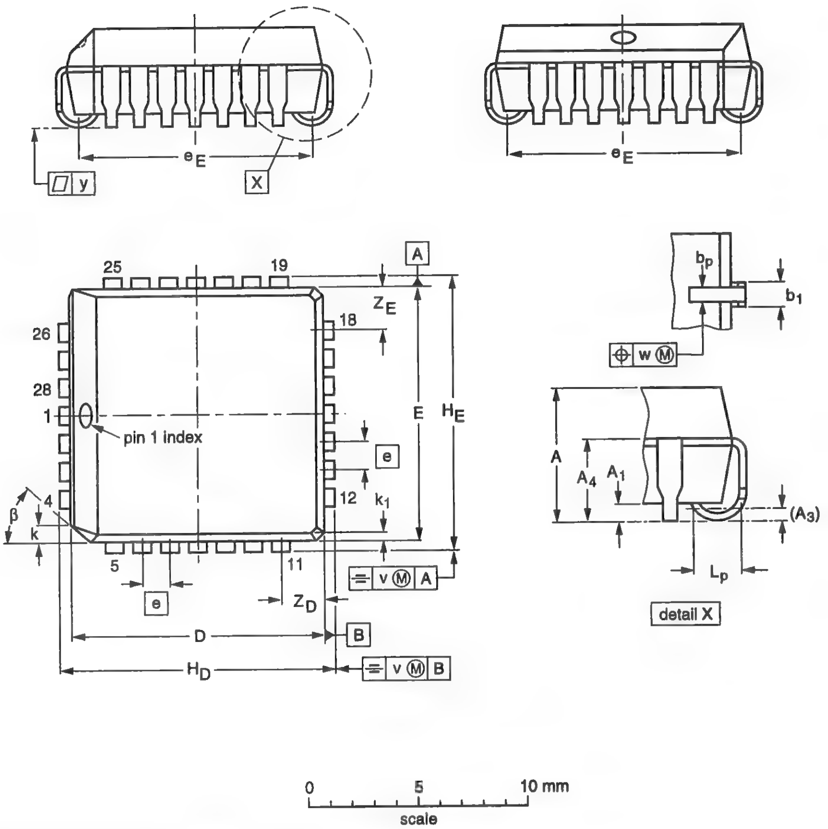
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	9.04 8.89	9.04 8.89	1.27	8.38 7.37	8.38 7.37	10.03 9.78	10.03 9.78	1.22 1.07	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.356 0.350	0.356 0.350	0.05	0.330 0.290	0.330 0.290	0.395 0.385	0.395 0.385	0.048 0.042	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT380-1		MO-047AA				~~92-11-17~~ 95-02-25

PLCC28: plastic leaded chip carrier; 28 leads **SOT261-2**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

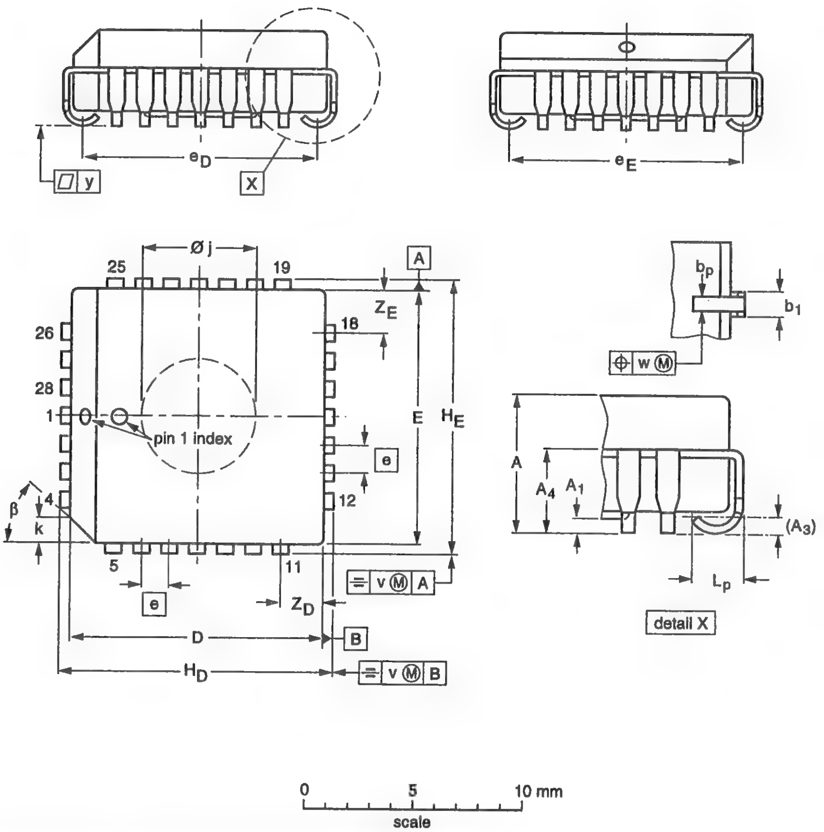
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	11.58 11.43	11.58 11.43	1.27	10.92 9.91	10.92 9.91	12.57 12.32	12.57 12.32	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.456 0.450	0.456 0.450	0.05	0.430 0.390	0.430 0.390	0.495 0.485	0.495 0.485	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT261-2						~~92-11-17~~ 95-02-25

PLCC28: plastic leaded chip carrier; 28 leads; pedestal **SOT261-3**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	$Ø_j$	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	11.58 11.43	11.58 11.43	1.27	10.92 9.91	10.92 9.91	12.57 12.32	12.57 12.32	1.22 1.07	5.69 5.54	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	0.456 0.450	0.456 0.450	0.05	0.430 0.390	0.430 0.390	0.495 0.485	0.495 0.485	0.048 0.042	0.224 0.218	0.057 0.040	0.007	0.007	0.004	0.081	0.081	

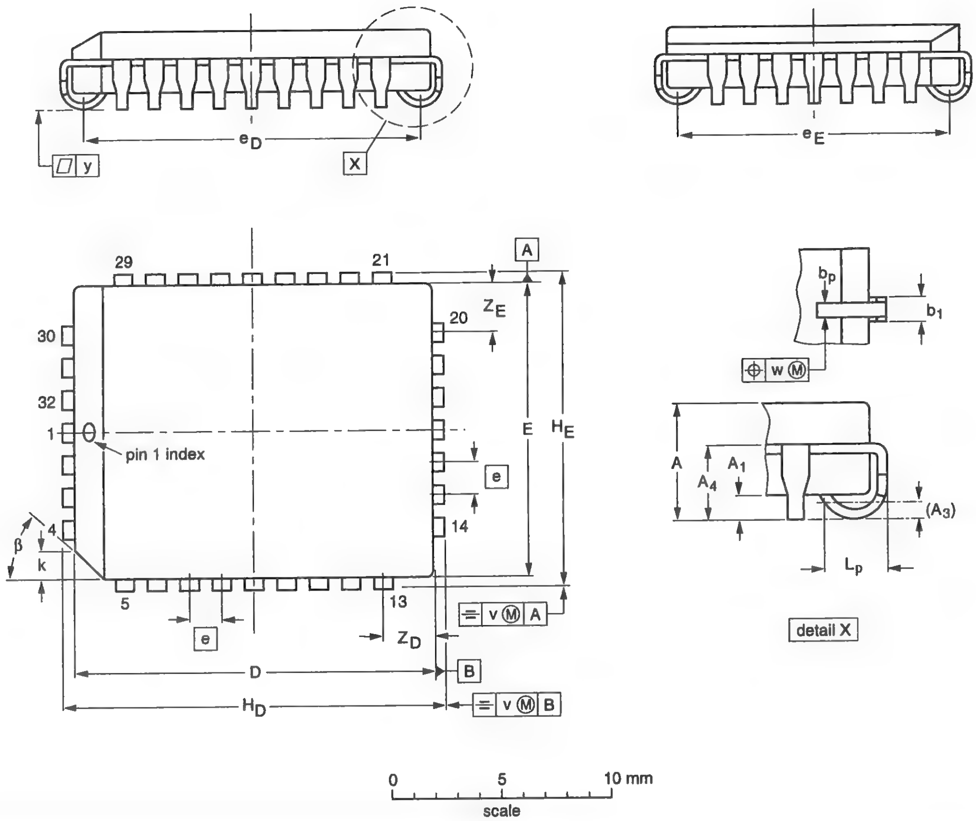
Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT261-3		MO-047AB				~~92-11-17~~ 95-02-25

PLCC32: plastic leaded chip carrier; 32 leads

SOT381-1



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	3.56 3.18	0.51	0.25	2.41	0.53 0.33	0.81 0.66	14.05 13.89	11.51 11.35	1.27	13.46 12.45	10.92 9.91	15.11 14.86	12.57 12.32	1.22 1.07	1.40 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.140 0.125	0.020	0.01	0.095	0.021 0.013	0.032 0.026	0.553 0.547	0.453 0.447	0.05	0.530 0.490	0.430 0.390	0.595 0.585	0.495 0.485	0.048 0.042	0.055 0.040	0.007	0.007	0.004	0.085	0.085	

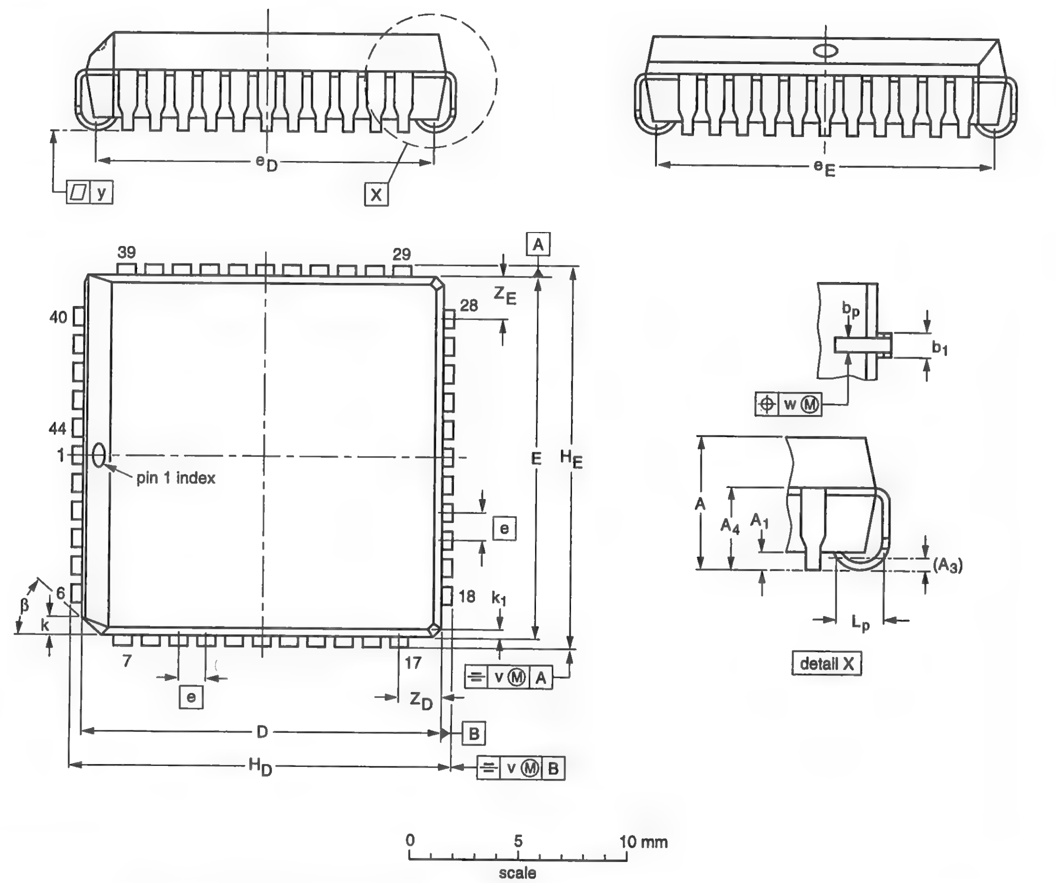
Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT381-1		MS-016AE				~~92-11-17~~ 95-03-11

PLCC44: plastic leaded chip carrier; 44 leads

SOT187-2



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	D(1)	E(1)	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	Z_D(1) max.	Z_E(1) max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	16.66 16.51	16.66 16.51	1.27	16.00 14.99	16.00 14.99	17.65 17.40	17.65 17.40	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.656 0.650	0.656 0.650	0.05	0.630 0.590	0.630 0.590	0.695 0.685	0.695 0.685	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

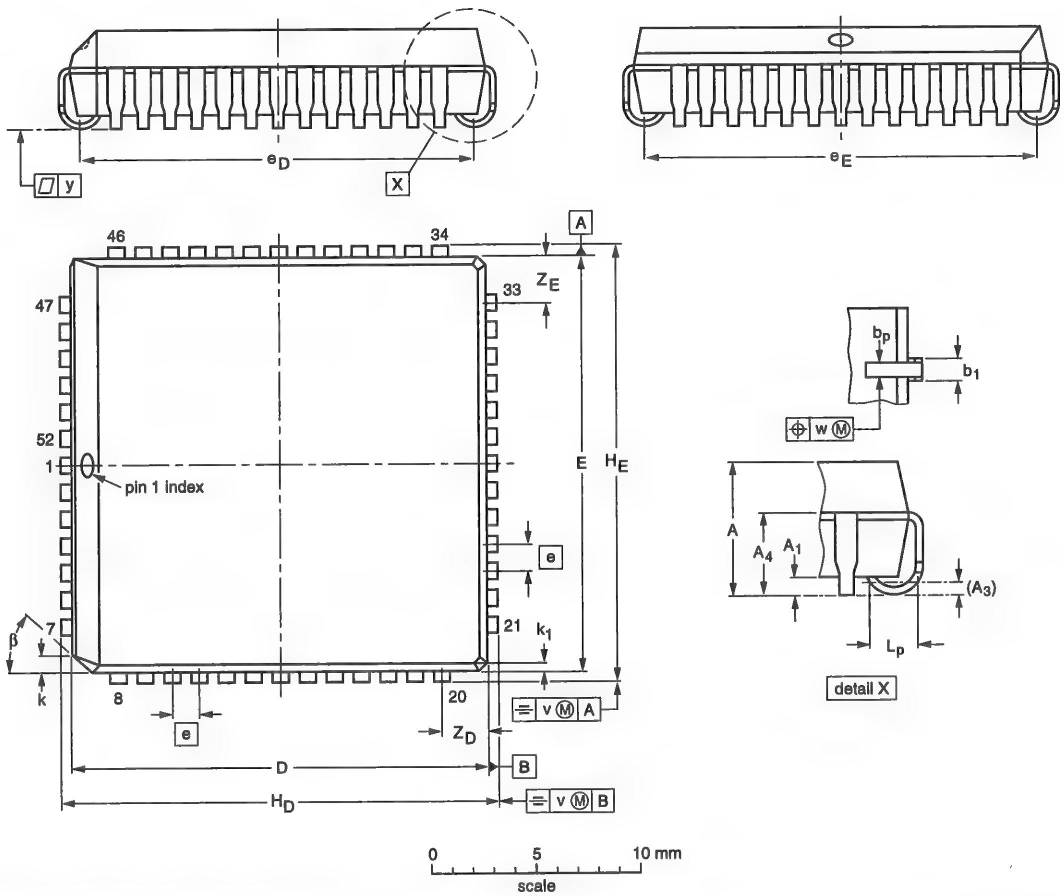
Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT187-2	112E10	MO-047AC				~~92-11-17~~ 95-02-25

PLCC52: plastic leaded chip carrier; 52 leads

SOT238-2



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	19.15 19.05	19.15 19.05	1.27	18.54 17.53	18.54 17.53	20.19 19.94	20.19 19.94	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.754 0.750	0.754 0.750	0.05	0.730 0.690	0.730 0.690	0.795 0.785	0.795 0.785	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

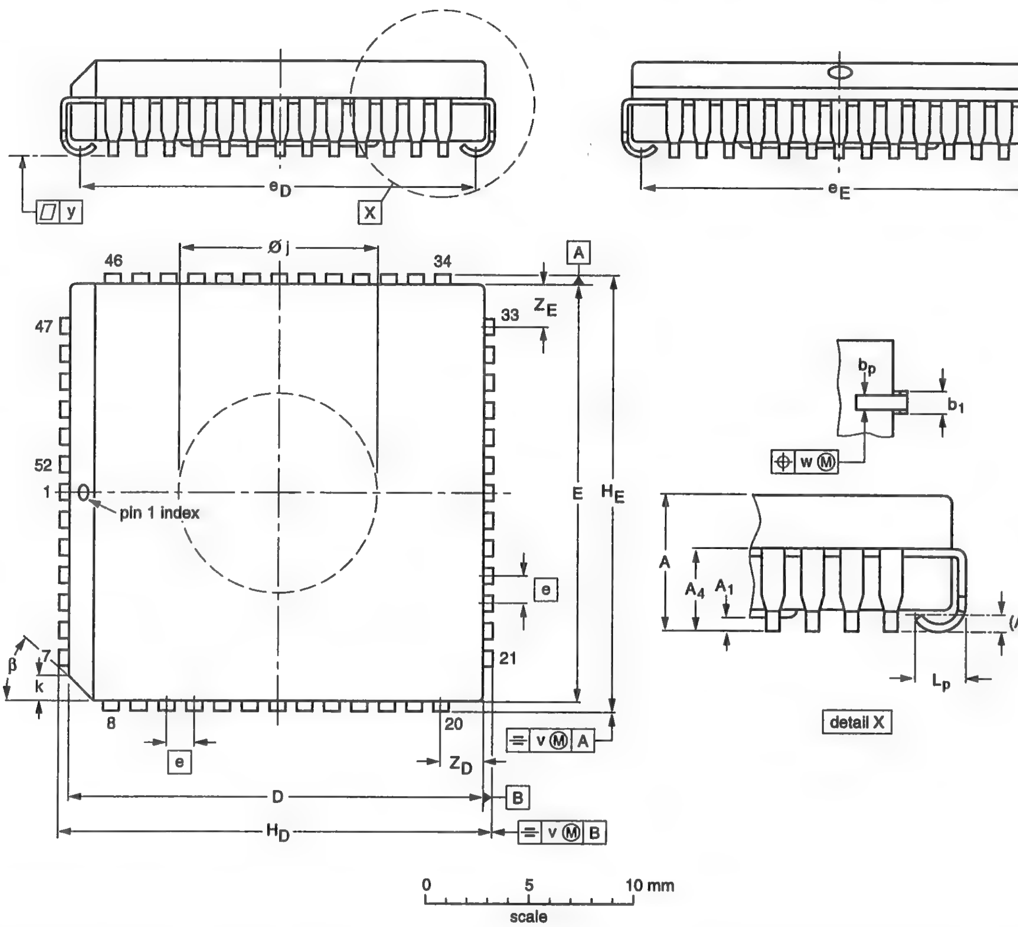
Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT238-2						~~92-10-08~~ 95-02-25

PLCC52: plastic leaded chip carrier; 52 leads; pedestal

SOT238-3



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

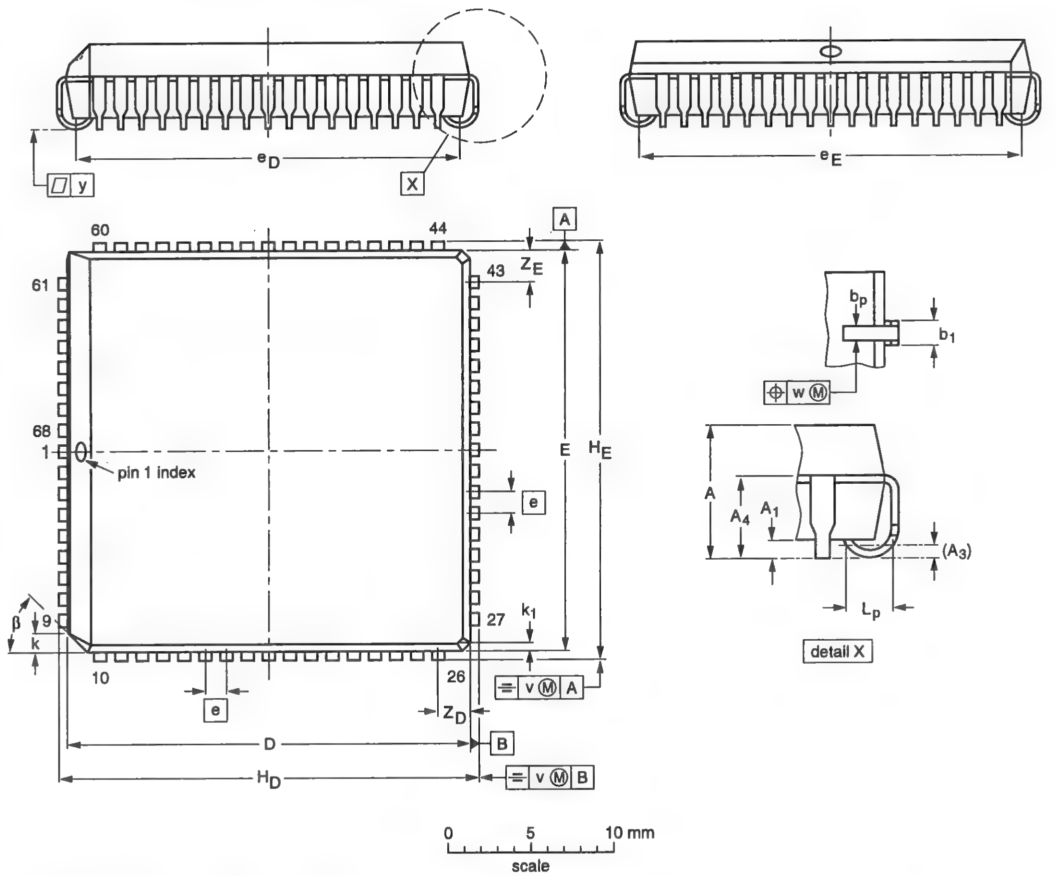
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	$Ø_j$	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	19.20 19.05	19.20 19.05	1.27	18.54 17.53	18.54 17.53	20.19 19.94	20.19 19.94	1.22 1.07	9.25 9.09	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	0.756 0.750	0.756 0.750	0.05	0.730 0.690	0.730 0.690	0.795 0.785	0.795 0.785	0.048 0.042	0.364 0.358	0.057 0.040	0.007	0.007	0.004	0.081	0.081	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT238-3		MO-047AD				~~92-10-08~~ 95-02-25

PLCC68: plastic leaded chip carrier; 68 leads **SOT188-2**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

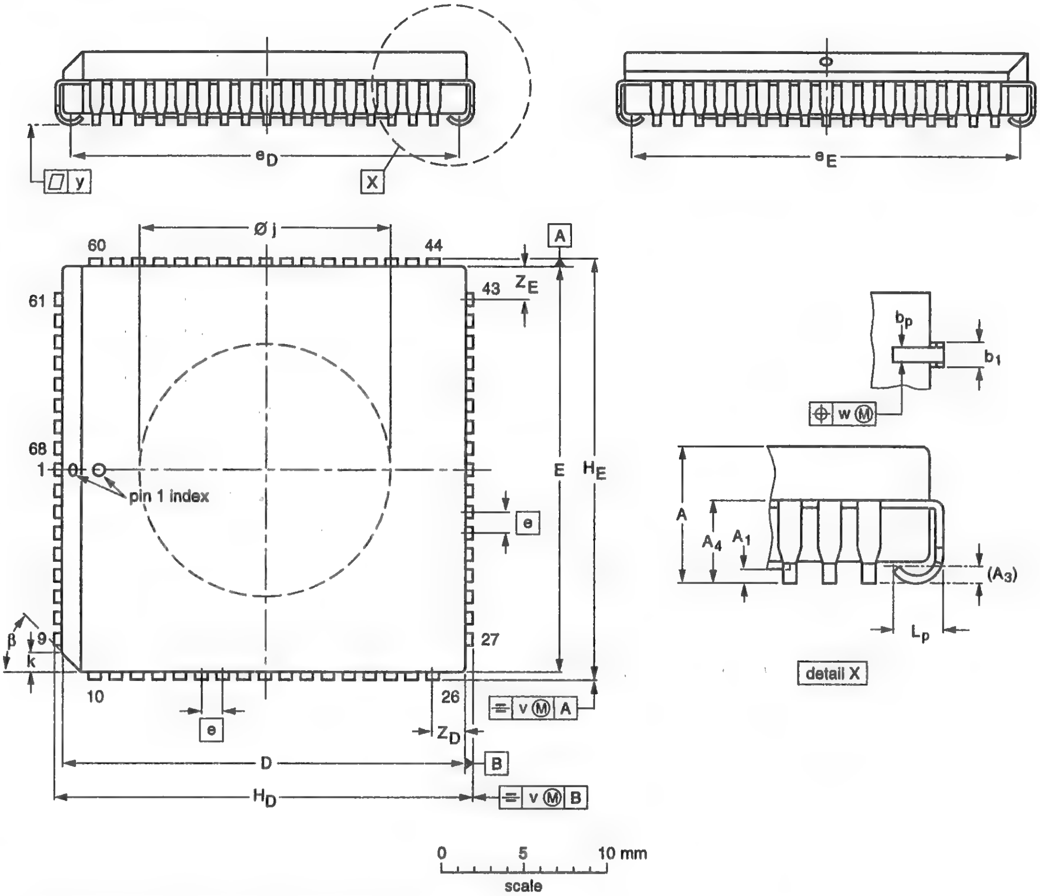
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.30	0.53 0.33	0.81 0.66	24.33 24.13	24.33 24.13	1.27	23.62 22.61	23.62 22.61	25.27 25.02	25.27 25.02	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.13	0.021 0.013	0.032 0.026	0.958 0.950	0.958 0.950	0.05	0.930 0.890	0.930 0.890	0.995 0.985	0.995 0.985	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT188-2	112E10	MO-047AC				~~92-11-17~~ 95-03-11

PLCC68: plastic leaded chip carrier; 68 leads; pedestal SOT188-3



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

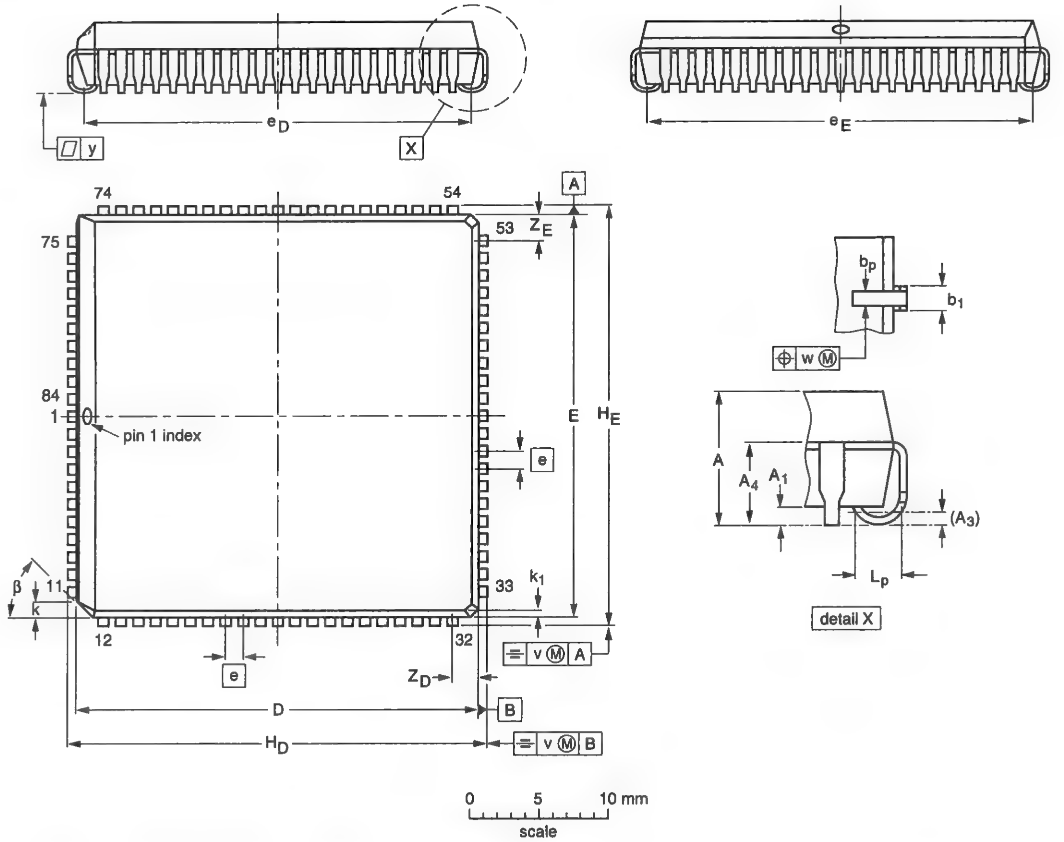
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	$Ø_j$	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	24.33 24.13	24.33 24.13	1.27	23.62 22.61	23.62 22.61	25.27 25.02	25.27 25.02	1.22 1.07	15.34 15.19	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	0.958 0.950	0.958 0.950	0.05	0.930 0.890	0.930 0.890	0.995 0.985	0.995 0.985	0.048 0.042	0.604 0.598	0.057 0.040	0.007	0.007	0.004	0.081	0.081	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT188-3	112E10	MO-047AE				~~92-11-17~~ 95-02-25

PLCC84: plastic leaded chip carrier; 84 leads **SOT189-2**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

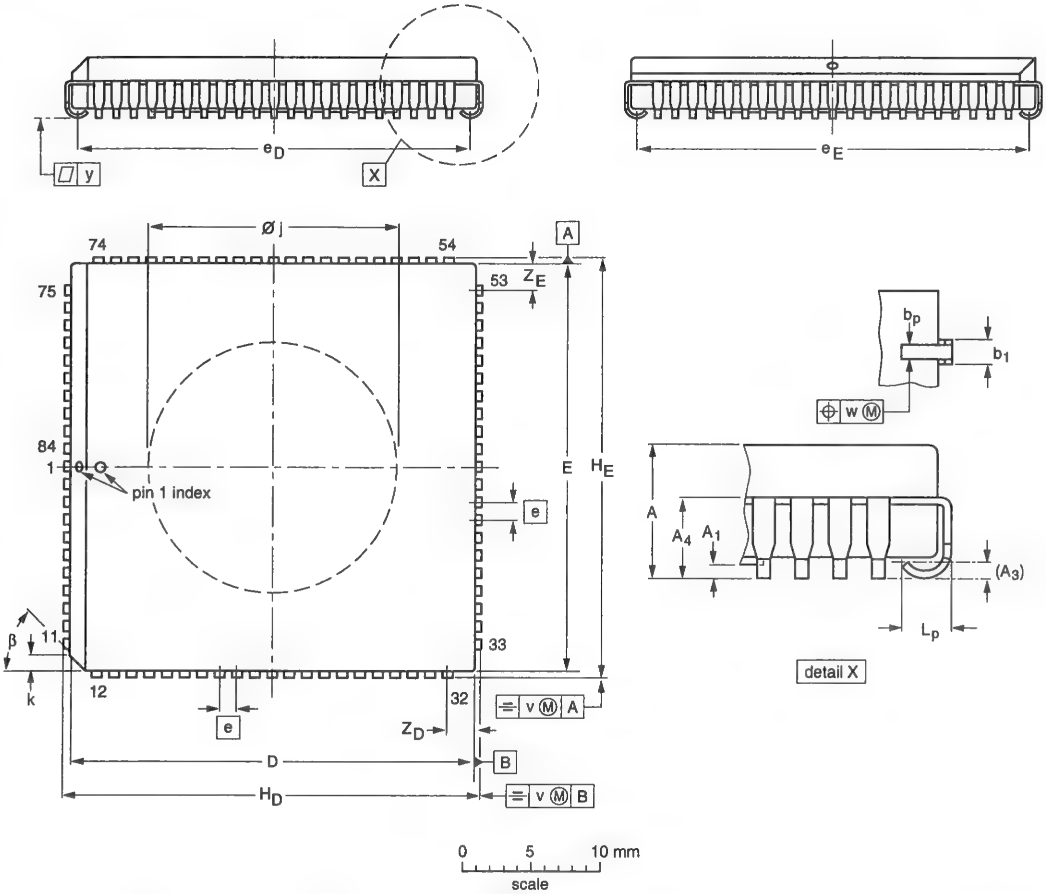
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.30	0.53 0.33	0.81 0.66	29.41 29.21	29.41 29.21	1.27	28.70 27.69	28.70 27.69	30.35 30.10	30.35 30.10	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.13	0.021 0.013	0.032 0.026	1.158 1.150	1.158 1.150	0.05	1.130 1.090	1.130 1.090	1.195 1.185	1.195 1.185	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT189-2						~~92-11-17~~ 95-03-11

PLCC84: plastic leaded chip carrier; 84 leads; pedestal **SOT189-3**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

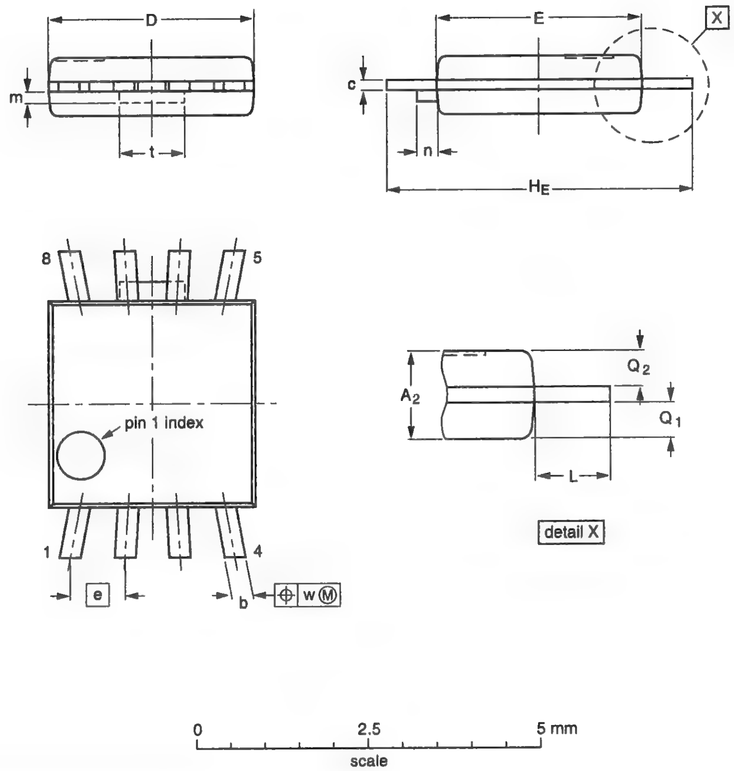
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	$Ø_j$	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	29.41 29.21	29.41 29.21	1.27	28.70 27.69	28.70 27.69	30.35 30.10	30.35 30.10	1.22 1.07	15.34 15.19	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	1.158 1.150	1.158 1.150	0.05	1.130 1.090	1.130 1.090	1.195 1.185	1.195 1.185	0.048 0.042	0.057 0.040	0.057 0.040	0.007	0.007	0.004	0.081	0.081	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT189-3		MO-047AF				~~92-11-17~~ 95-02-25

PMFP8: plastic micro flat package; 8 leads (straight) **SOT144-1**



DIMENSIONS (mm are the original dimensions)

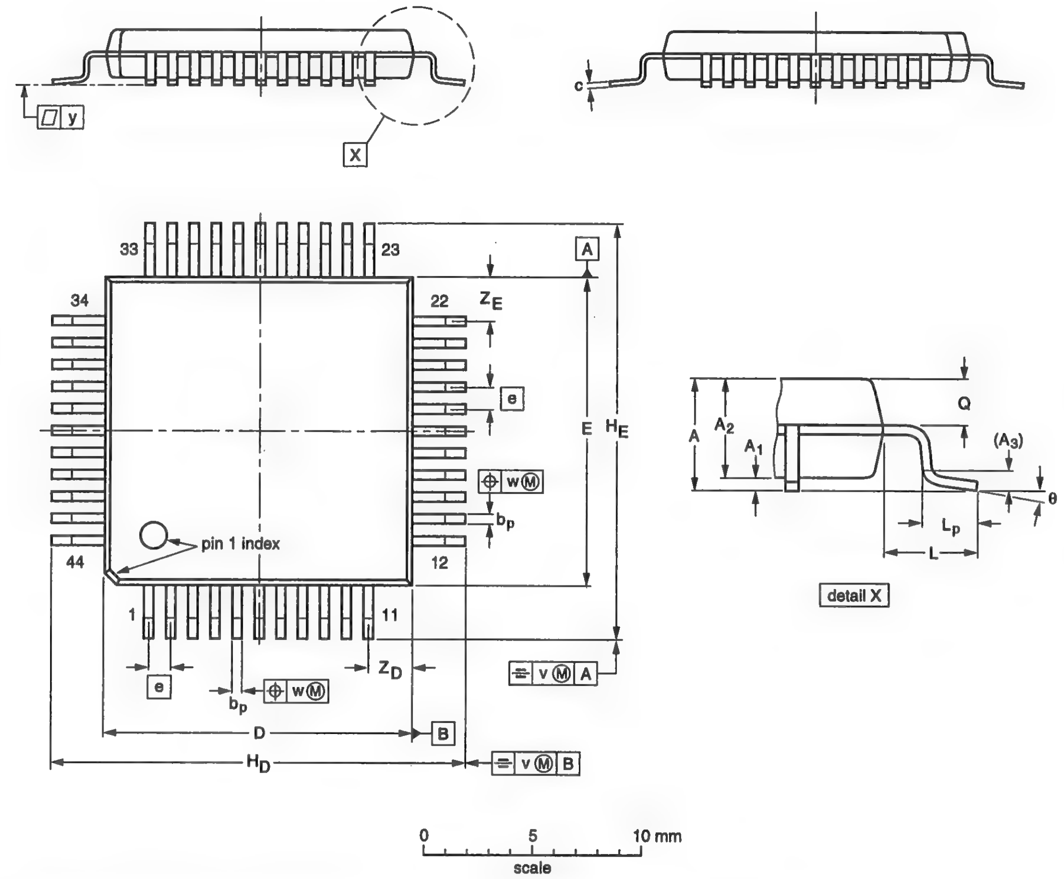
UNIT	A_2	b	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	m max.	n max.	Q_1	Q_2	t	w
mm	0.90 0.70	0.40 0.25	0.19 0.12	3.1 2.9	3.1 2.9	0.80	4.6 4.4	0.75	0.26	0.3	0.40 0.30	0.40 0.30	0.95	0.1

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT144-1						~~94-01-25~~ 95-01-24

QFP44: plastic quad flat package; 44 leads (lead length 2.35 mm); body 14 x 14 x 2.2 mm **SOT205-1**



DIMENSIONS (mm are the original dimensions)

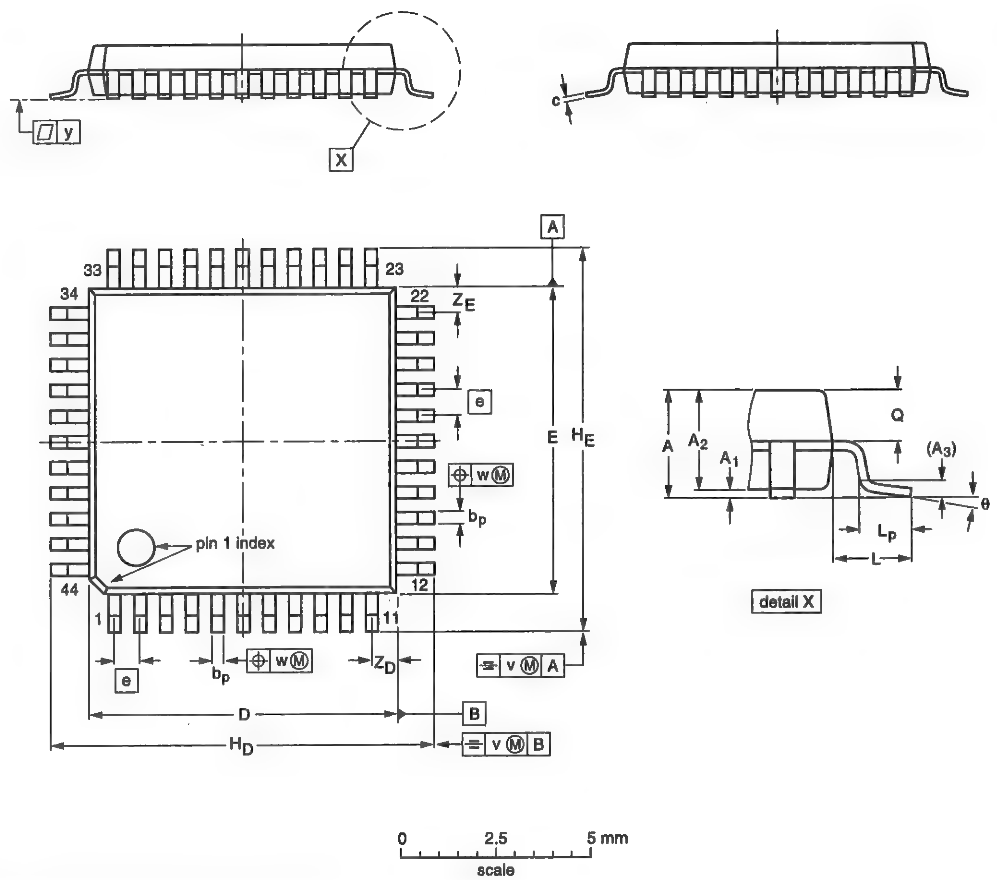
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	2.60	0.25 0.05	2.3 2.1	0.25	0.50 0.35	0.25 0.14	14.1 13.9	14.1 13.9	1	19.2 18.2	19.2 18.2	2.35	2.0 1.2	1.2 0.9	0.3	0.15	0.1	2.4 1.8	2.4 1.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT205-1	133E01A					~~92-11-17~~ 95-02-04

QFP44: plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 x 10 x 1.75 mm **SOT307-2**



DIMENSIONS (mm are the original dimensions)

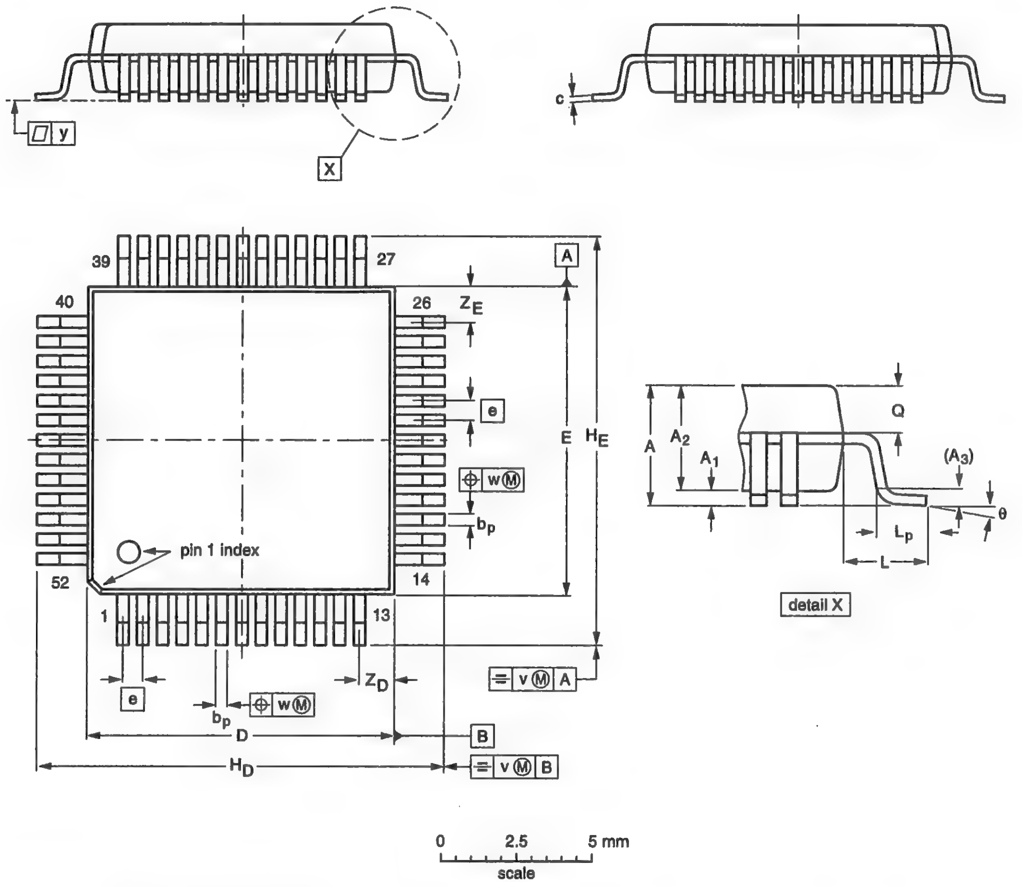
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	2.10	0.25 0.05	1.85 1.65	0.25	0.40 0.20	0.25 0.14	10.1 9.9	10.1 9.9	0.8	12.9 12.3	12.9 12.3	1.3	0.95 0.55	0.85 0.75	0.15	0.15	0.1	1.2 0.8	1.2 0.8	10° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT307-2						~~92-11-17~~ 95-02-04

QFP52: plastic quad flat package; 52 leads (lead length 1.6 mm); body 10 x 10 x 2.0 mm **SOT379-1**



DIMENSIONS (mm are the original dimensions)

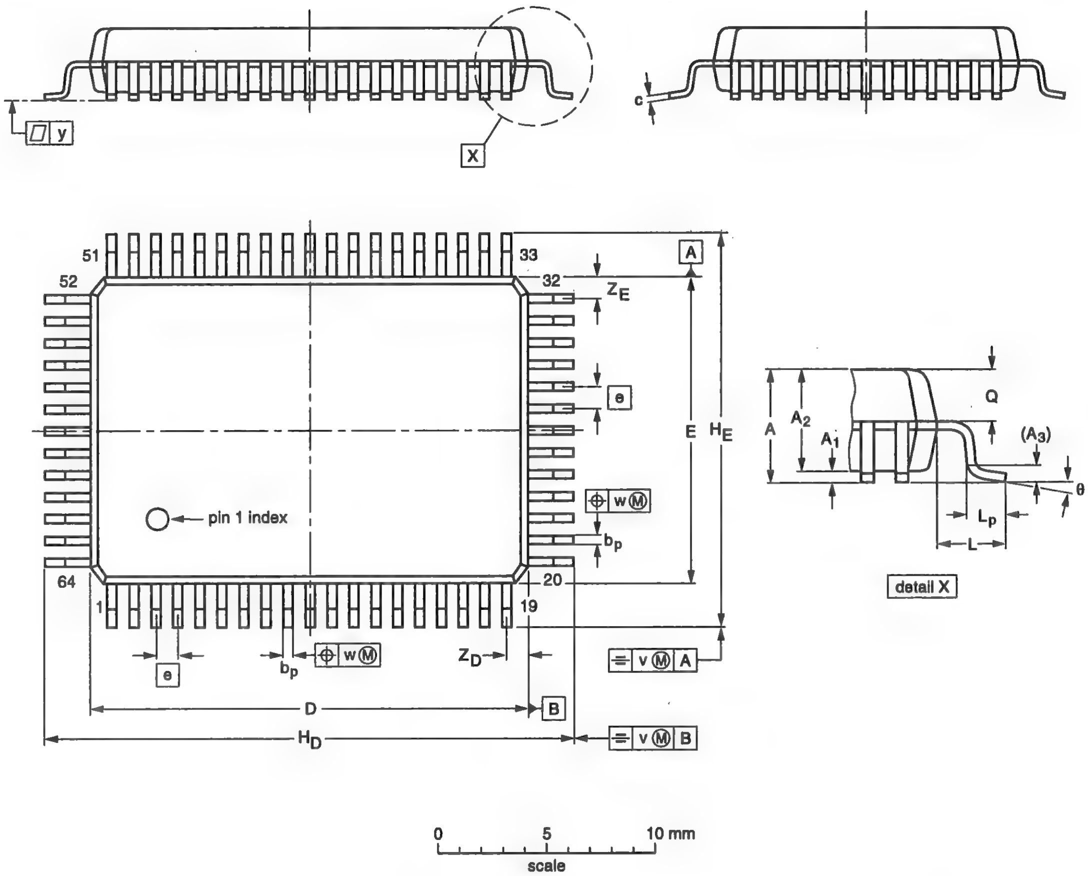
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	2.45	0.45 0.25	2.10 1.95	0.25	0.38 0.22	0.23 0.13	10.1 9.9	10.1 9.9	0.65	13.45 12.95	13.45 12.95	1.60	0.95 0.65	1.05 0.90	0.20	0.12	0.10	1 24 0.95	1.24 0.95	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT379-1		MO-108				95-02-04

QFP64: plastic quad flat package;
64 leads (lead length 1.95 mm); body 14 x 20 x 2.7 mm; high stand-off height **SOT319-1**



DIMENSIONS (mm are the original dimensions)

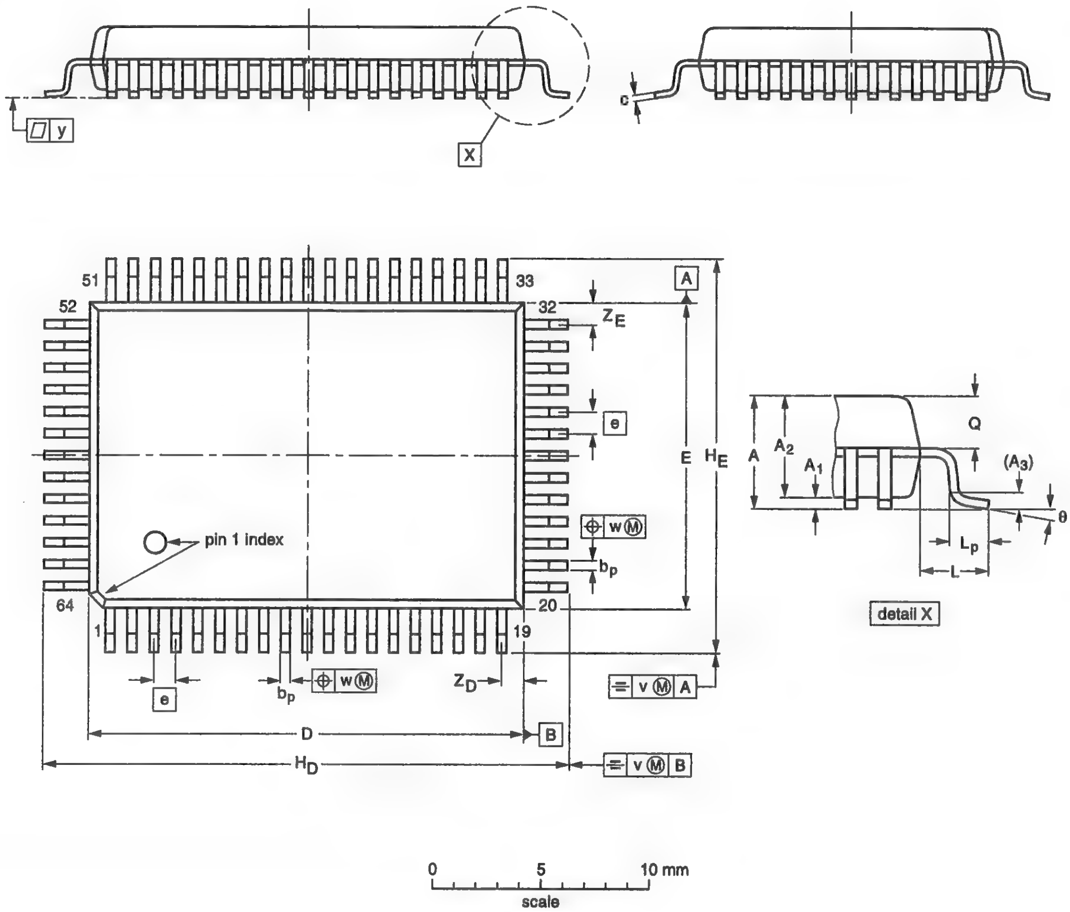
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.50 0.35	0.25 0.13	20.1 19.9	14.1 13.9	1	24.2 23.6	18.2 17.6	1.95	1.0 0.6	1.43 1.23	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT319-1						~~92-11-17~~ 95-02-04

QFP64: plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm **SOT319-2**



DIMENSIONS (mm are the original dimensions)

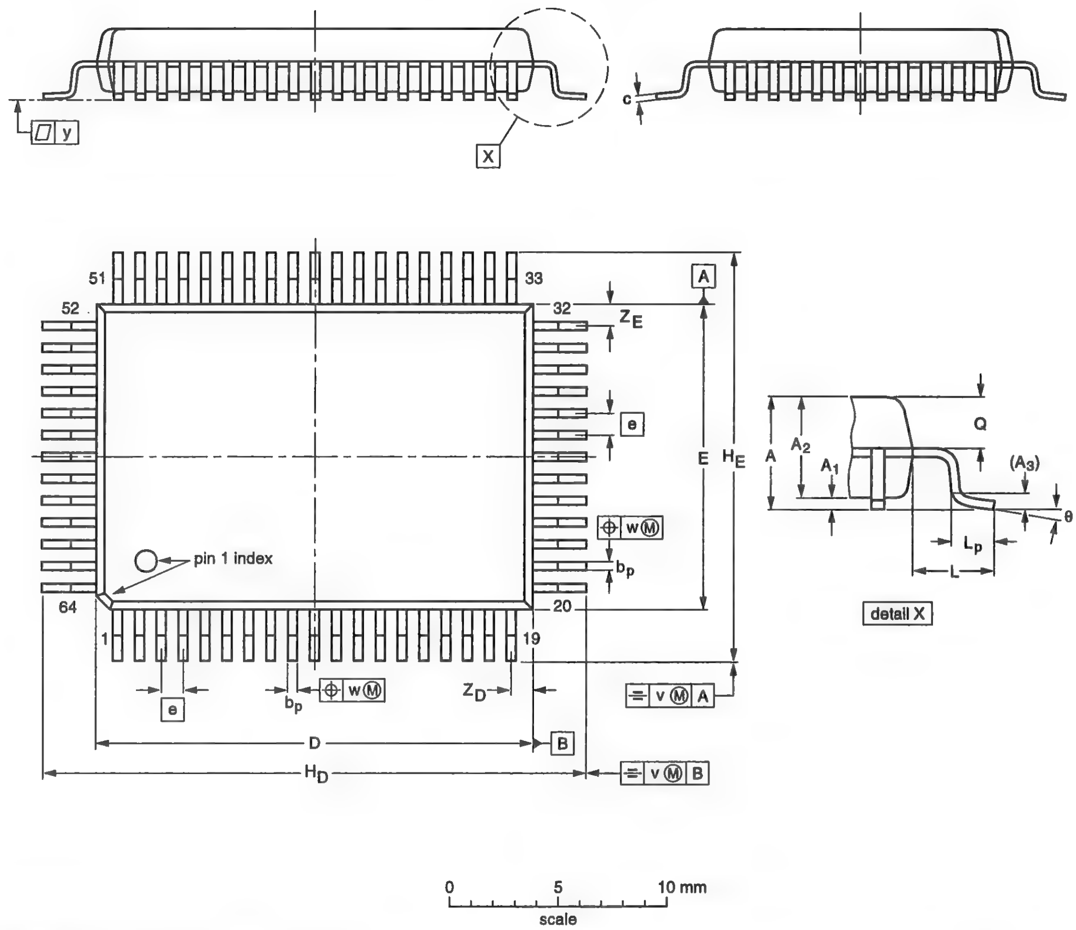
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.20	0.25 0.05	2.90 2.65	0.25	0.50 0.35	0.25 0.14	20.1 19.9	14.1 13.9	1	24.2 23.6	18.2 17.6	1.95	1.0 0.6	1.4 1.2	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT319-2						~~92-11-17~~ 95-02-04

QFP64: plastic quad flat package; 64 leads (lead length 2.35 mm); body 14 x 20 x 2.8 mm **SOT319-3**



DIMENSIONS (mm are the original dimensions)

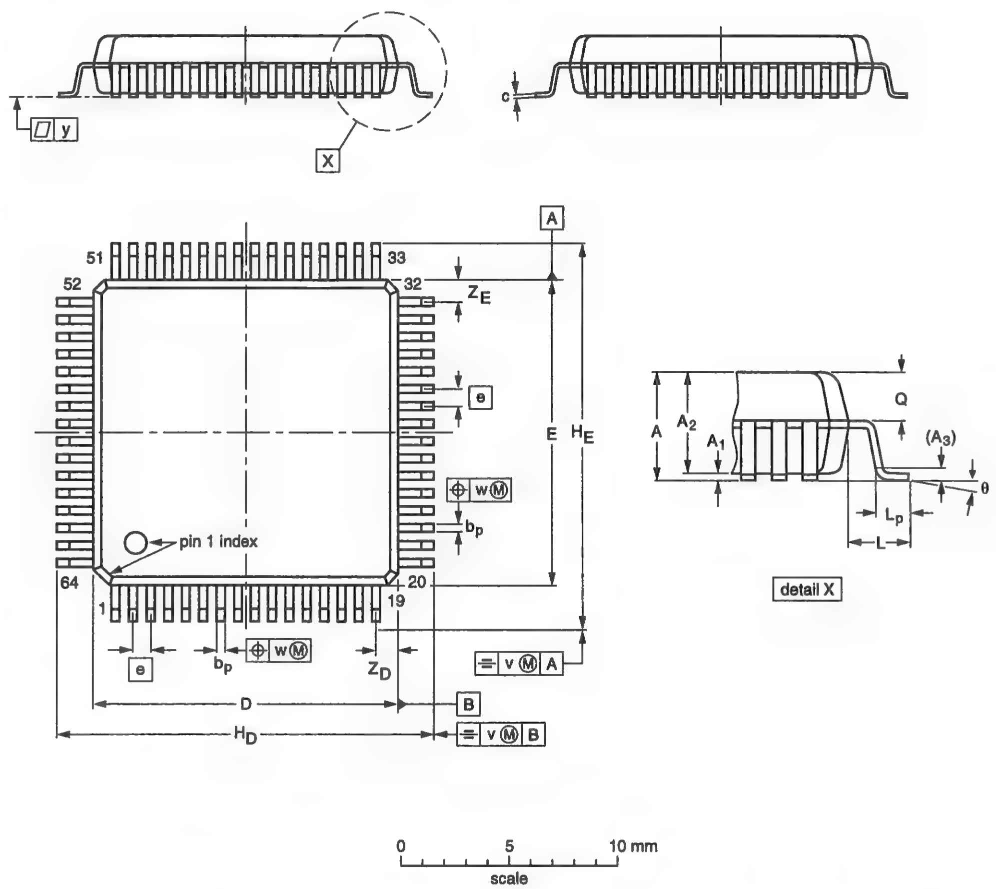
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.25	0.30 0.10	2.90 2.65	0.25	0.50 0.35	0.25 0.14	20.1 19.9	14.1 13.9	1	25.0 24.4	19.0 18.4	2.35	1.4 1.0	1.4 1.2	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT319-3						~~94-03-22~~ 95-02-04

QFP64: plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 x 14 x 2.7 mm **SOT393-1**



DIMENSIONS (mm are the original dimensions)

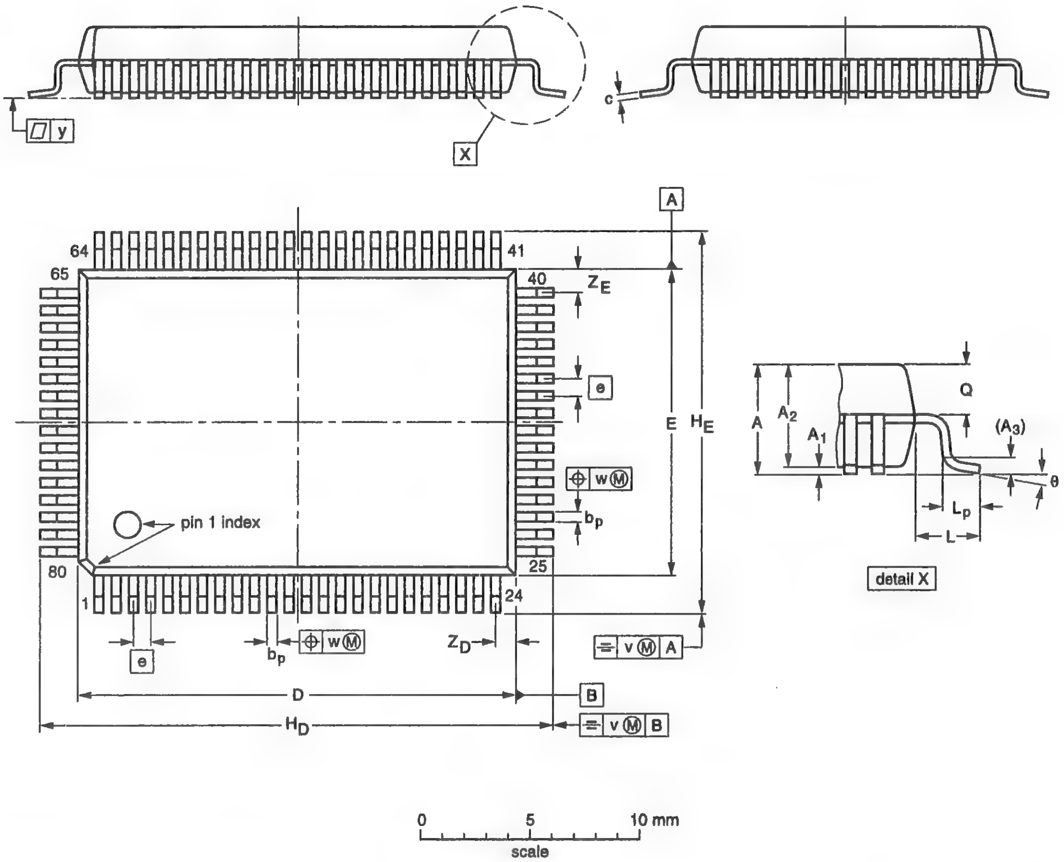
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.00	0.25 0.10	2.75 2.55	0.25	0.45 0.30	0.23 0.13	14.1 13.9	14.1 13.9	0.8	17.45 16.95	17.45 16.95	1.60	1.03 0.73	1.4 1.1	0.16	0.16	0.10	1.2 0.8	1.2 0.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT393-1		MO-108BD-2				~~94-06-22~~ 95-02-04

QFP80: plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 x 20 x 3.0 mm **SOT310-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.4	0.2 0	3.2 2.8	0.25	0.45 0.30	0.25 0.14	20.1 19.9	14.1 13.9	0.8	23.6 22.8	17.6 16.8	1.6	1.1 0.5	1.55 1.25	0.3	0.15	0.1	1.0 0.6	1.2 0.8	7° 0°

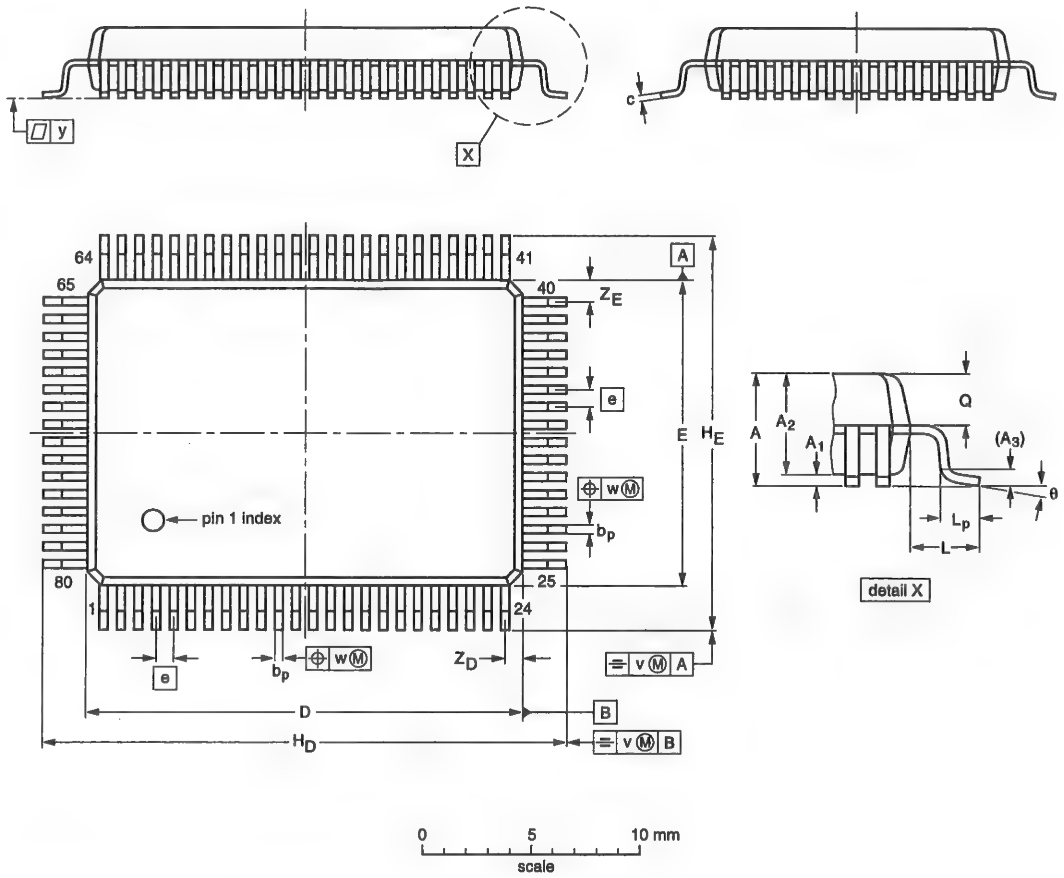
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT310-1						~~92-06-30~~ 95-02-04

QFP80: plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 x 20 x 2.7 mm; high stand-off height

SOT318-1



DIMENSIONS (mm are the original dimensions)

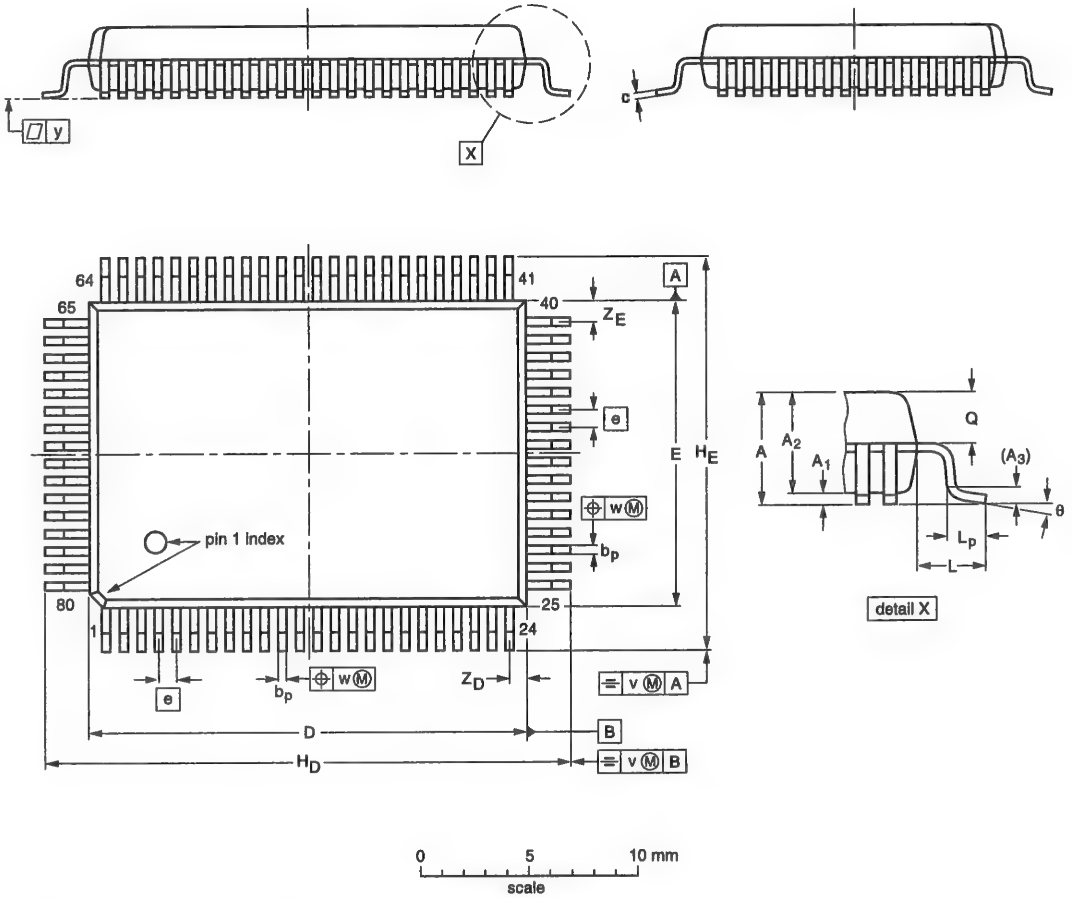
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.45 0.30	0.25 0.13	20.1 19.9	14.1 13.9	0.8	24.2 23.6	18.2 17.6	1.95	1.0 0.6	1.43 1.23	0.2	0.2	0.1	1.0 0.6	1.2 0.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT318-1						~~92-11-17~~ 95-02-04

QFP80: plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm **SOT318-2**



DIMENSIONS (mm are the original dimensions)

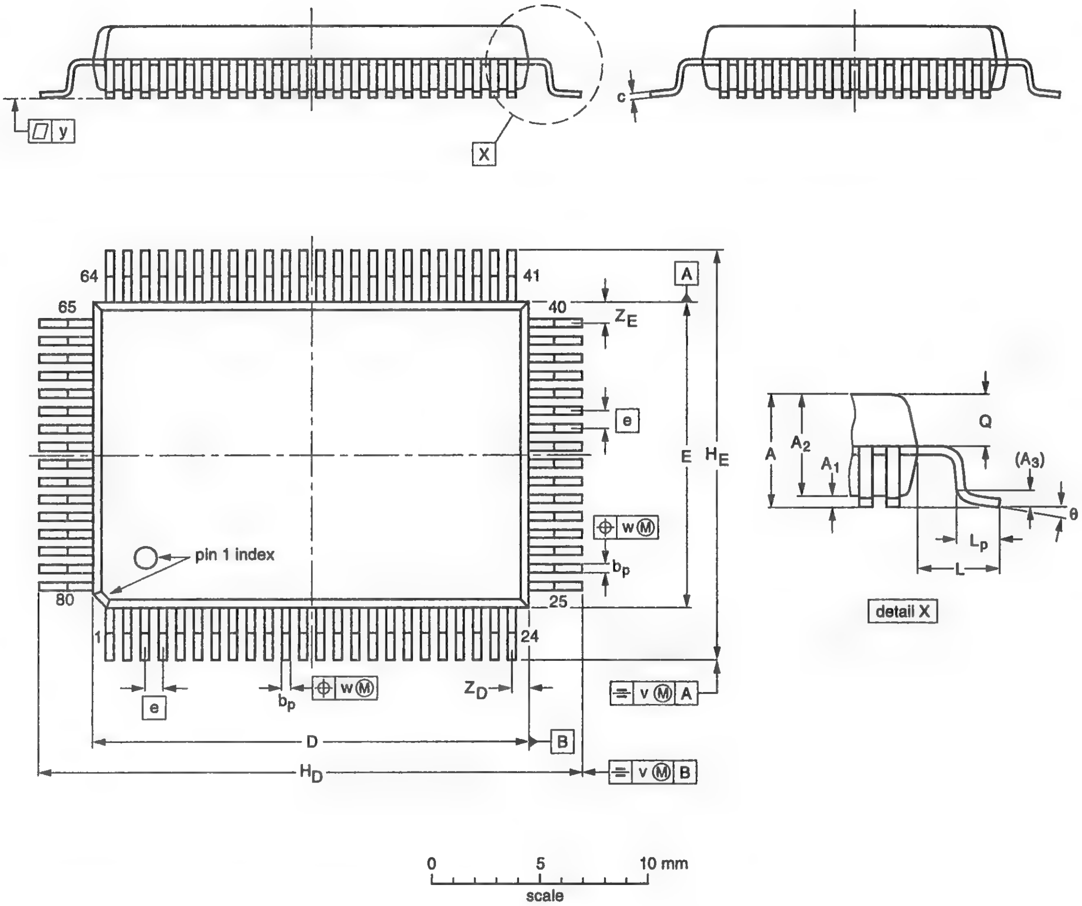
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.2	0.25 0.05	2.90 2.65	0.25	0.45 0.30	0.25 0.14	20.1 19.9	14.1 13.9	0.8	24.2 23.6	18.2 17.6	1.95	1.0 0.6	1.4 1.2	0.2	0.2	0.1	1.0 0.6	1.2 0.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT318-2						~~92-12-15~~ 95-02-04

QFP80: plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm **SOT318-3**

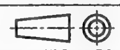


DIMENSIONS (mm are the original dimensions)

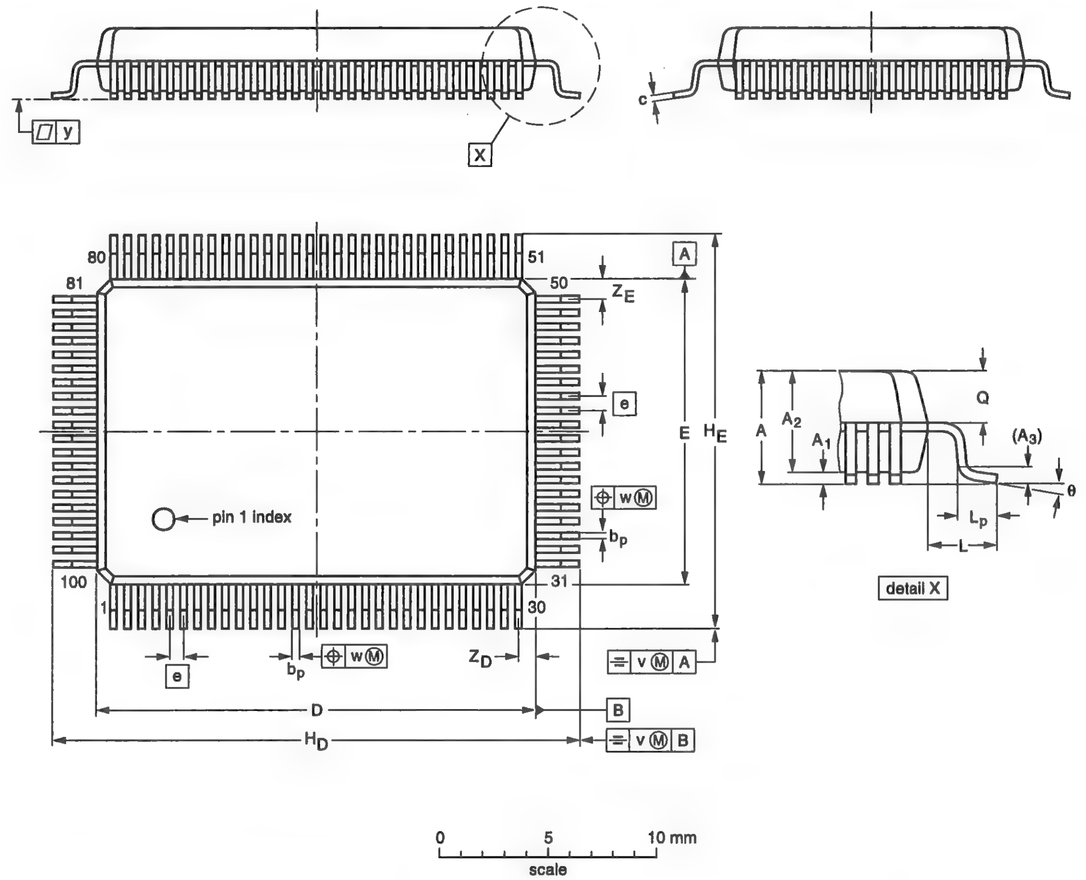
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.25	0.30 0.10	2.90 2.65	0.25	0.45 0.30	0.25 0.14	20.1 19.9	14.1 13.9	0.8	25.0 24.4	19.0 18.4	2.35	1.4 1.0	1.4 1.2	0.2	0.2	0.1	1.0 0.6	1.2 0.8	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT318-3						~~94-03-22~~ 95-02-04

QFP100: plastic quad flat package;
100 leads (lead length 1.95 mm); body 14 x 20 x 2.7 mm; high stand-off height **SOT317-1**



DIMENSIONS (mm are the original dimensions)

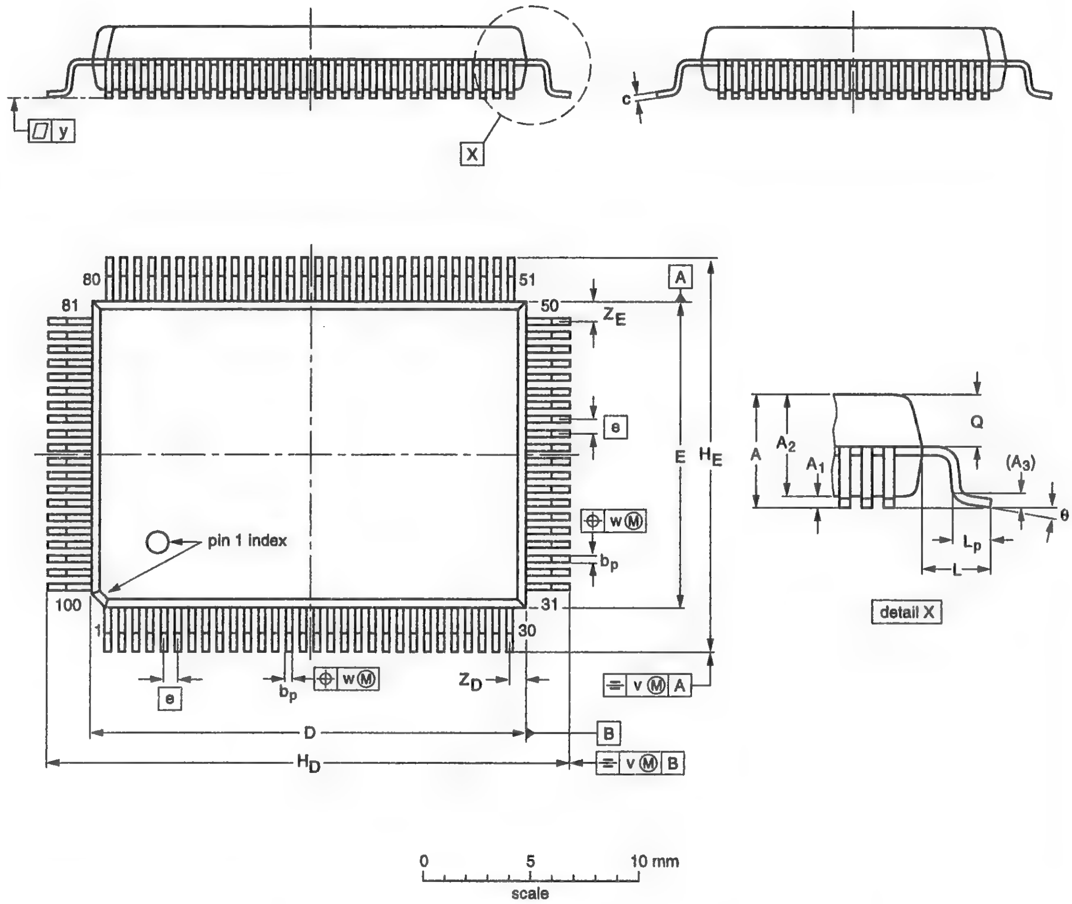
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.40 0.25	0.25 0.13	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.0 0.6	1.43 1.23	0.2	0.15	0.1	0.8 0.4	1.0 0.6	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT317-1						~~92-11-17~~ 95-02-04

QFP100: plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm SOT317-2



DIMENSIONS (mm are the original dimensions)

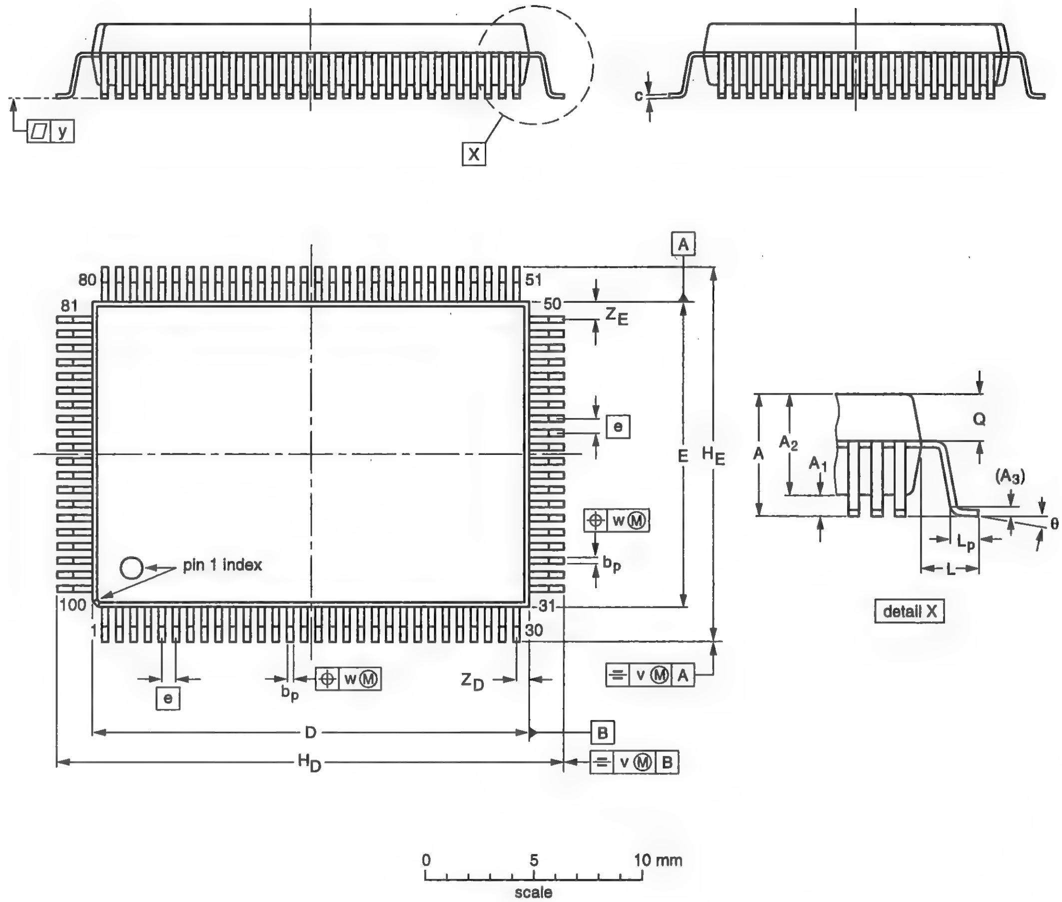
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.20	0.25 0.05	2.90 2.65	0.25	0.40 0.25	0.25 0.14	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.0 0.6	1.4 1.2	0.2	0.15	0.1	0.8 0.4	1.0 0.6	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT317-2						~~92-11-17~~ 95-02-04

QFP100: plastic quad flat package; 100 leads (lead length 1.6 mm); body 14 x 20 x 2.8 mm **SOT382-1**



DIMENSIONS (mm are the original dimensions)

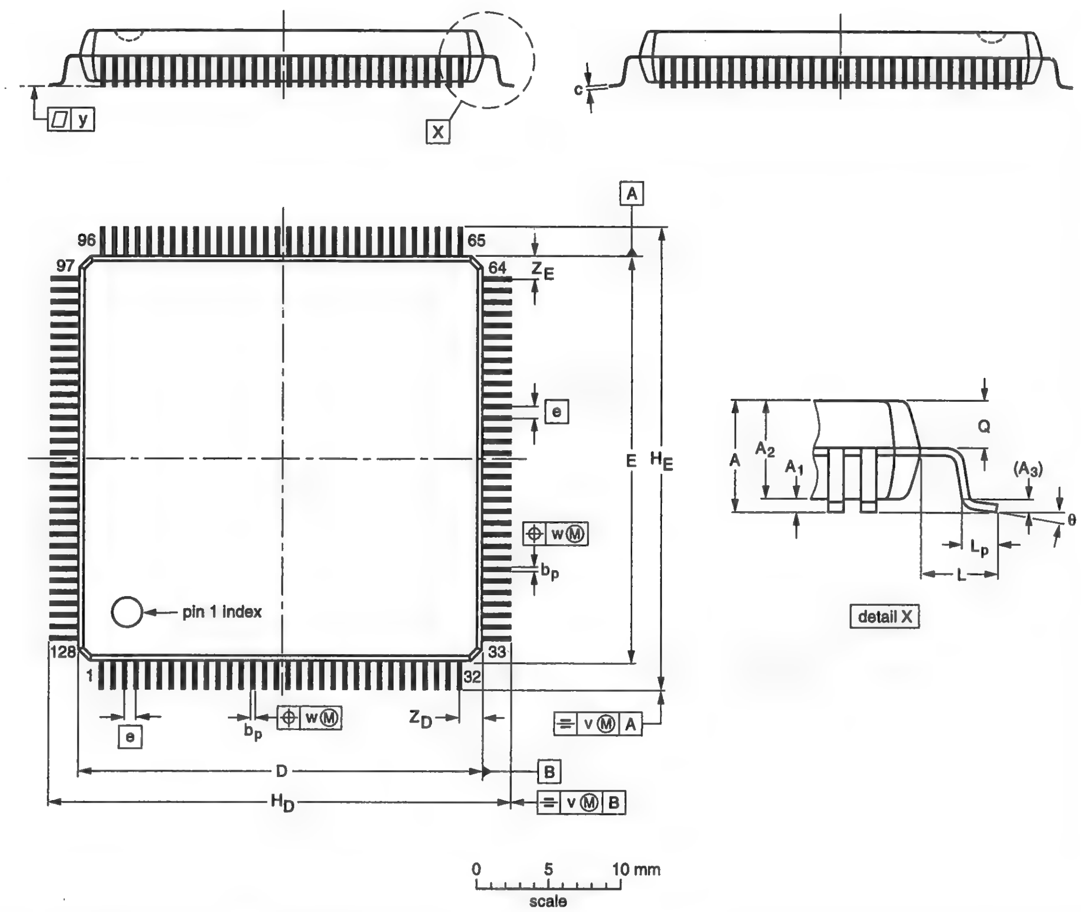
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.40	0.60 0.25	3.05 2.55	0.25	0.38 0.22	0.23 0.13	20.1 19.1	14.1 13.9	0.65	23.45 22.95	17.45 16.95	1.60	1.03 0.73	1.4 1.2	0.20	0.12	0.10	0.68 0.45	0.68 0.45	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT382-1		MO-108CC-1				~~94-12-12~~ 95-02-04

QFP128: plastic quad flat package;
128 leads (lead length 1.95 mm); body 28 x 28 x 3.4 mm; high stand-off height **SOT320-1**



DIMENSIONS (mm are the original dimensions)

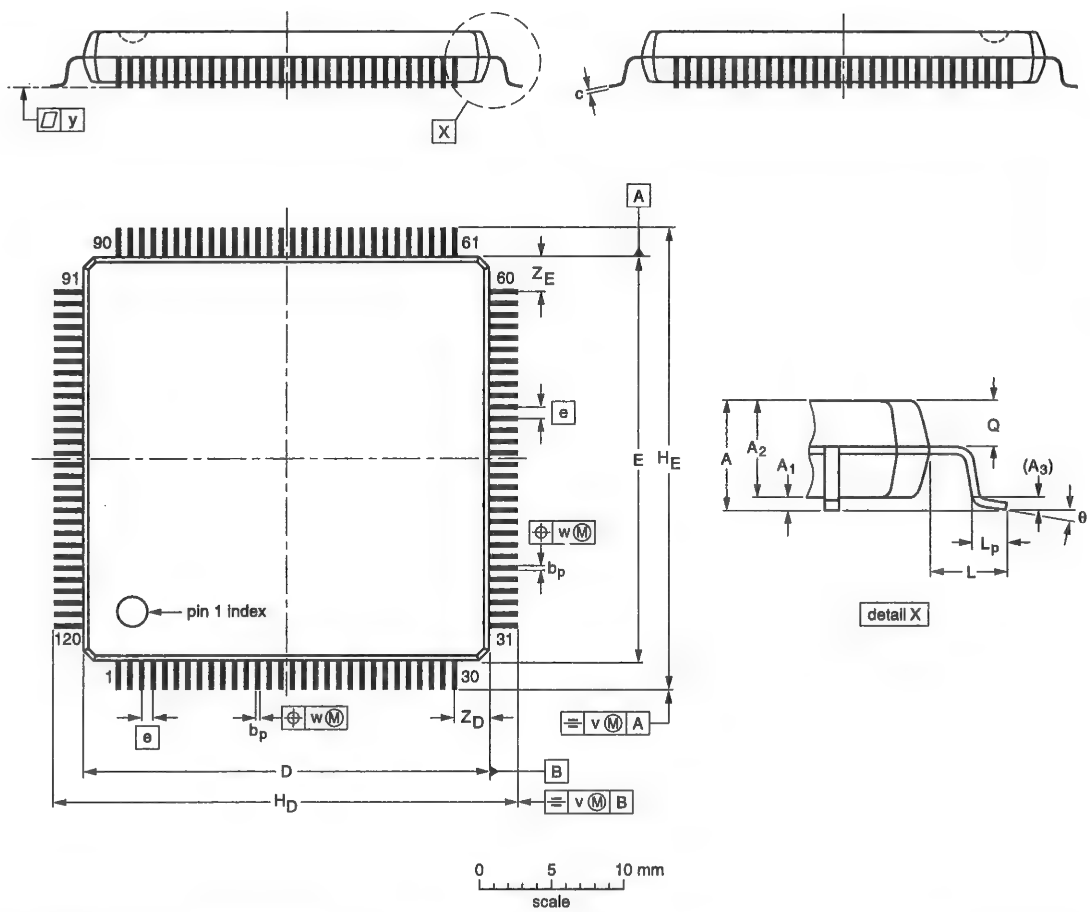
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.95	0.40 0.25	3.70 3.15	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	32.2 31.6	32.2 31.6	1.95	1.1 0.7	1.70 1.55	0.3	0.2	0.1	1.8 1.4	1.8 1.4	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT320-1						~~93-10-19~~ 95-02-04

QFP120: plastic quad flat package;
120 leads (lead length 1.95 mm); body 28 x 28 x 3.4 mm; high stand-off height **SOT349-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.95	0.40 0.25	3.70 3.15	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	32.2 31.6	32.2 31.6	1.95	1.1 0.7	1.70 1.55	0.3	0.2	0.1	2.6 2.2	2.6 2.2	8° 0°

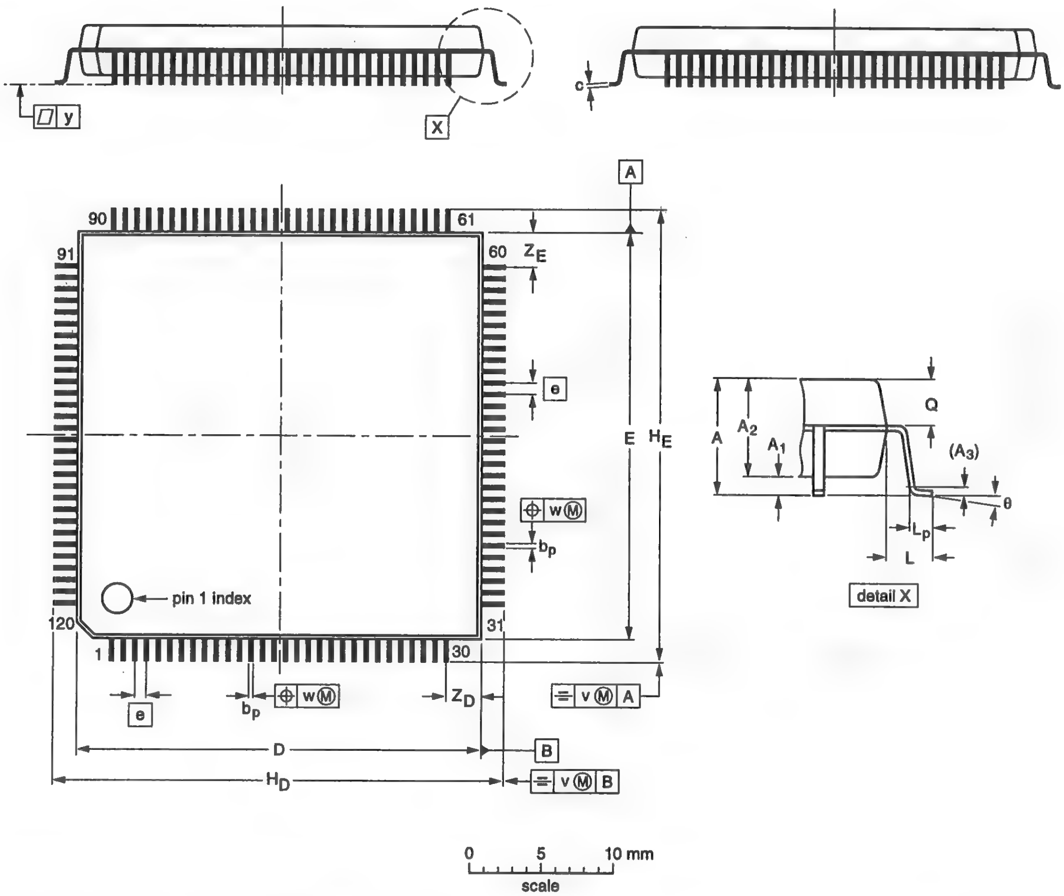
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT349-1						~~93-08-25~~ 95-02-04

QFP120: plastic quad flat package; 120 leads (lead length 1.6 mm); body 28 x 28 x 3.4 mm

SOT383-1



DIMENSIONS (mm are the original dimensions)

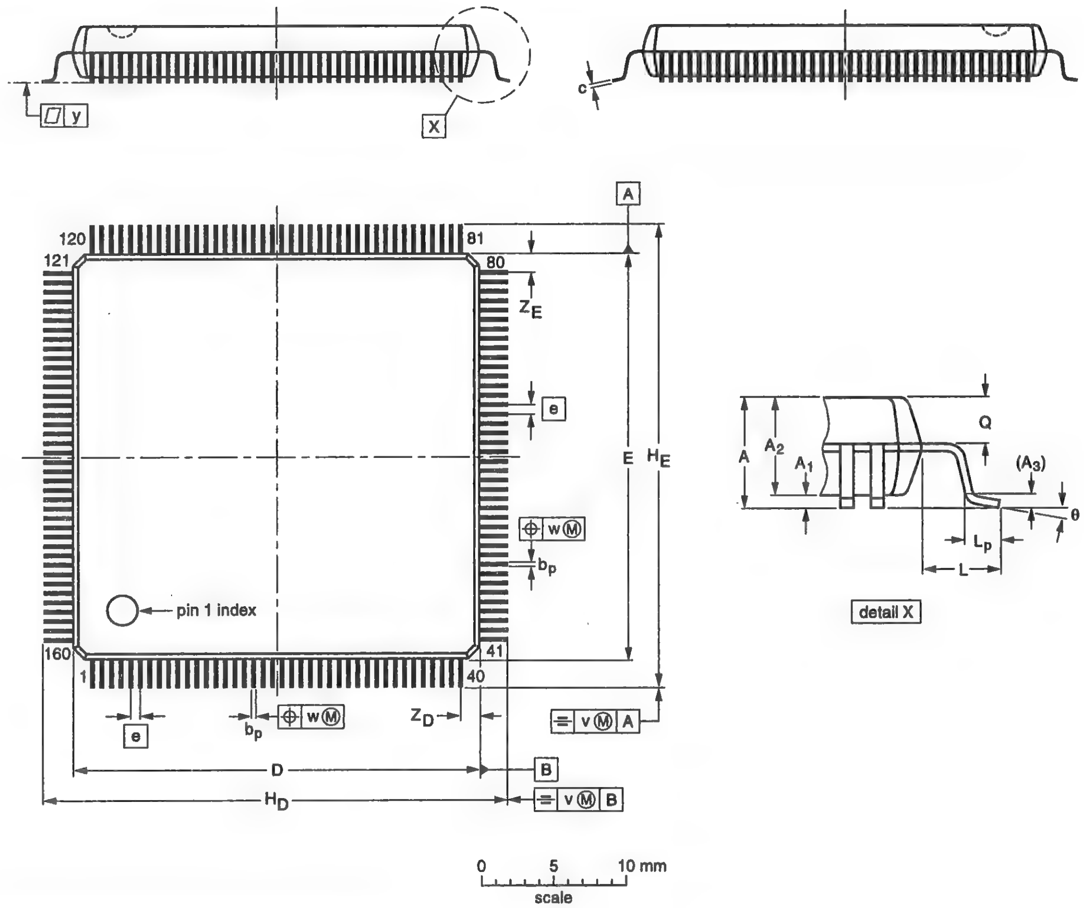
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	4.07	0.65 0.25	3.67 3.17	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	31.45 30.95	31.45 30.95	1.60	0.95 0.65	1.70 1.50	0.2	0.2	0.1	2.48 2.25	2.48 2.25	7° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT383-1		MO-108-1990				95-02-25

QFP160: plastic quad flat package;
160 leads (lead length 1.95 mm); body 28 x 28 x 3.4 mm; high stand-off height **SOT322-1**



DIMENSIONS (mm are the original dimensions)

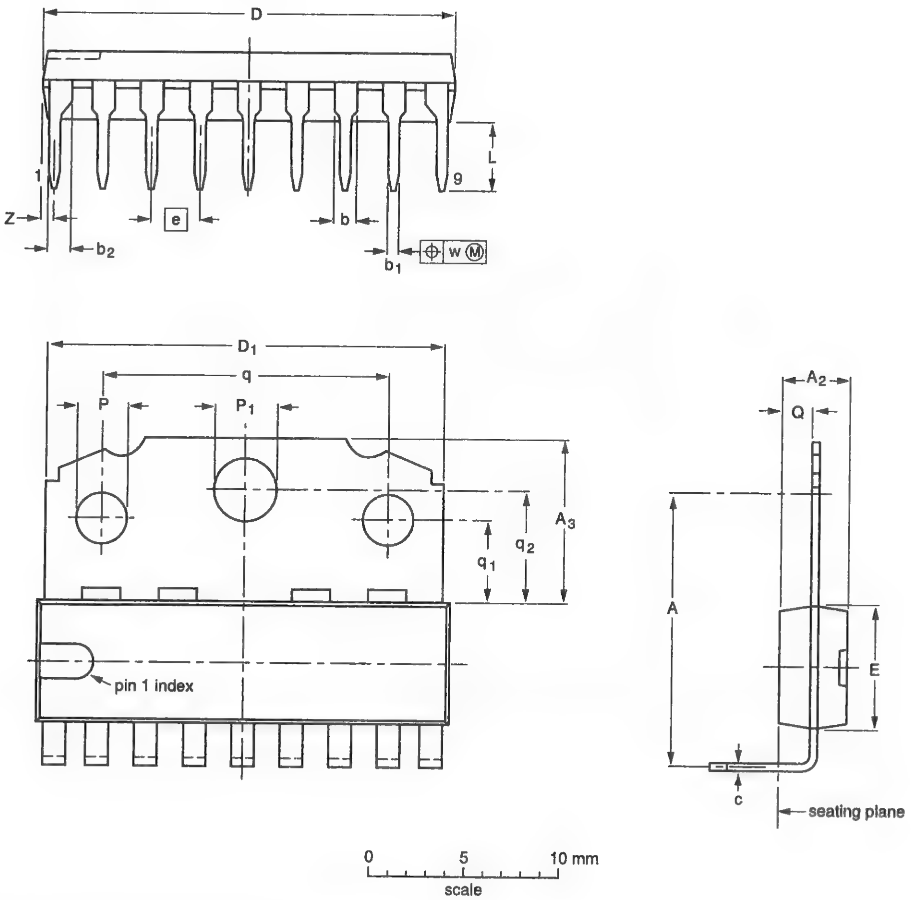
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.95	0.40 0.25	3.70 3.15	0.25	0.40 0.25	0.23 0.13	28.1 27.9	28.1 27.9	0.65	32.2 31.6	32.2 31.6	1.95	1.1 0.7	1.70 1.55	0.3	0.15	0.1	1.5 1.1	1.5 1.1	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT322-1		MO112DD1				~~93-08-25~~ 95-02-04

RBS9MPF: plastic rectangular-bent single in-line medium power package with fin; 9 leads **SOT352-1**



DIMENSIONS (mm are the original dimensions)

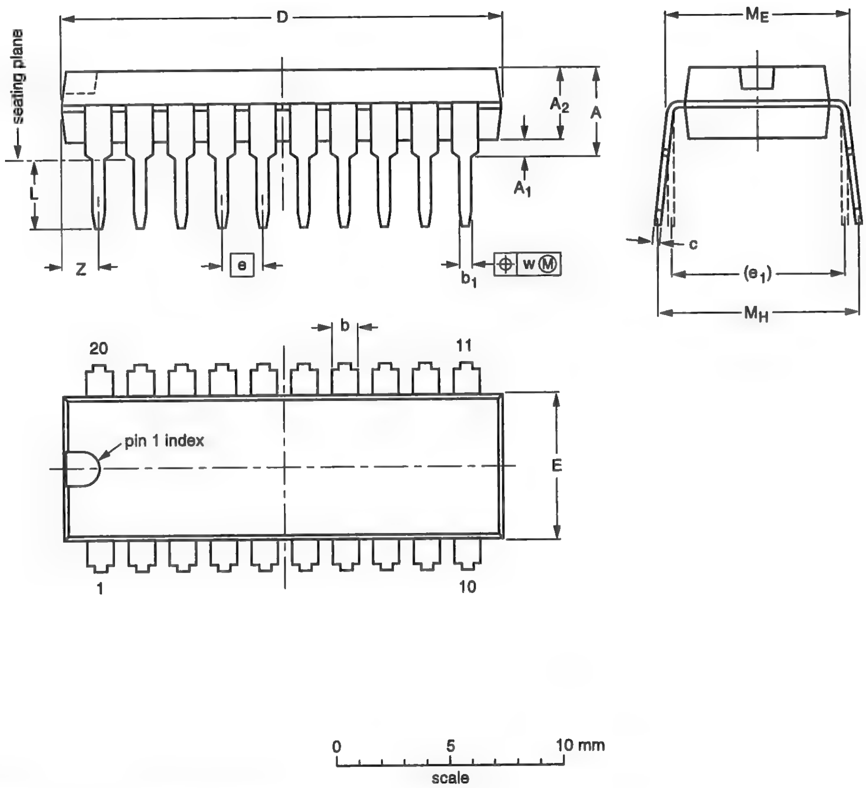
UNIT	A(1)	A2 max.	A3	b	b1	b2	c	D(2)	D1	E(2)	e	L	P	P1	Q	q	q1	q2	w	Z(2) max.
mm	14.45 13.95	3.7	8.7 8.0	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	3.8 3.3	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.40	1.0

Note

1. Dimension is specified at seating plane
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT352-1						~~92-10-07~~ 95-03-11

SDIP20: plastic shrink dual in-line package; 20 leads (300 mil) **SOT325-1**



DIMENSIONS (mm are the original dimensions)

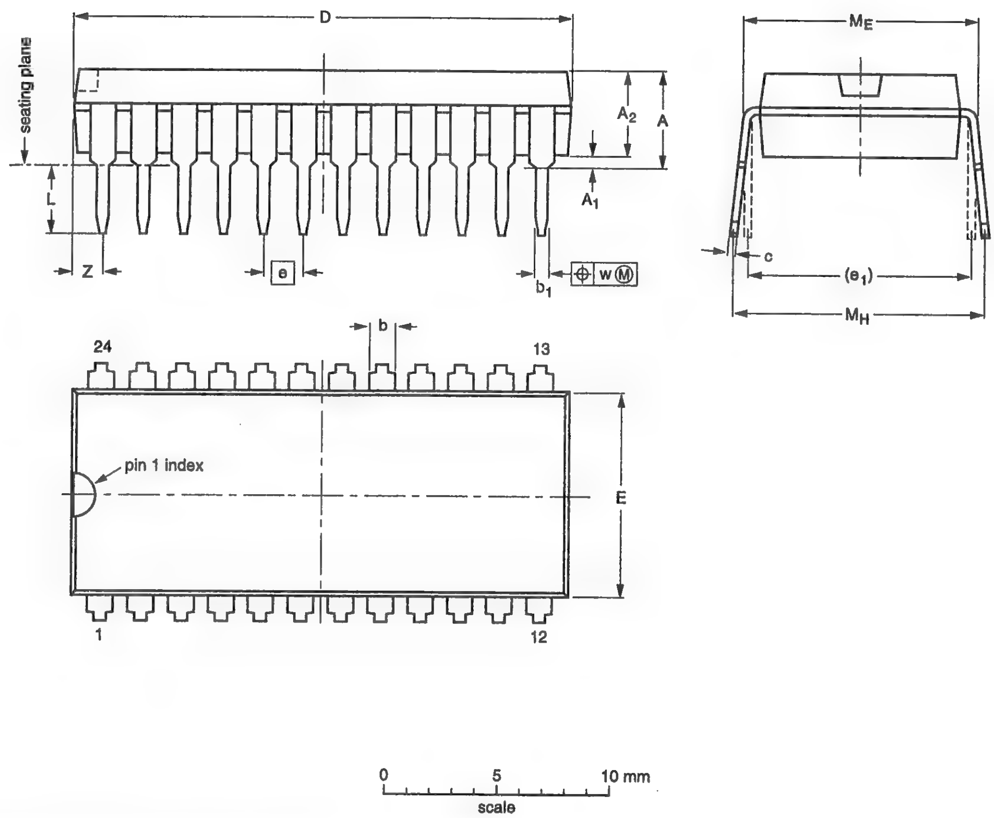
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D[(1)]	E[(1)]	e	e_1	L	M_E	M_H	w	Z[(1)] max.
mm	4.2	0.51	3.2	1.3 1.0	0.53 0.38	0.32 0.20	19.50 18.55	6.48 6.14	1.778	7.62	3.2 2.8	8.25 7.80	10.0 8.3	0.18	1.9

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT325-1						~~92-10-13~~ 95-02-04

SDIP24: plastic shrink dual in-line package; 24 leads (400 mil) **SOT234-1**



DIMENSIONS (mm are the original dimensions)

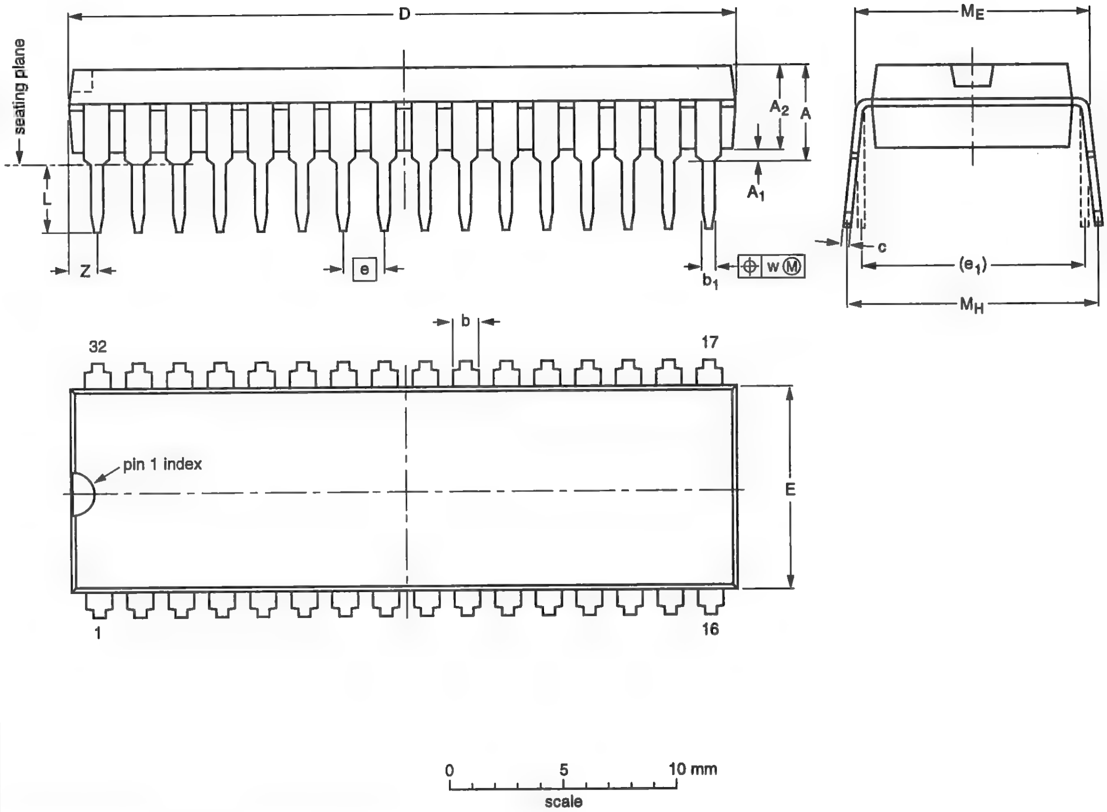
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	22.3 21.4	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT234-1						~~92-11-17~~ 95-02-04

SDIP32: plastic shrink dual in-line package; 32 leads (400 mil) **SOT232-1**



DIMENSIONS (mm are the original dimensions)

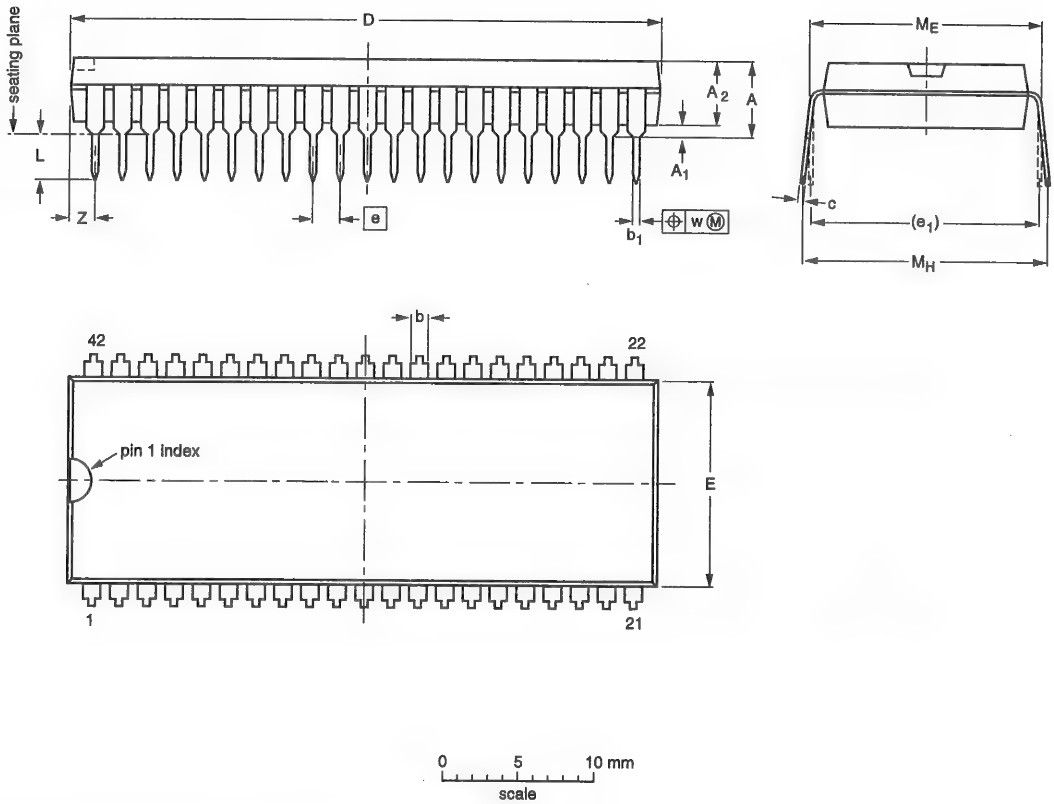
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D [(1)]	E [(1)]	e	e_1	L	M_E	M_H	w	Z [(1)] max.
mm	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	29.4 28.5	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT232-1						~~92-11-17~~ 95-02-04

SDIP42: plastic shrink dual in-line package; 42 leads (600 mil) **SOT270-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D[(1)]	E[(1)]	e	e_1	L	M_E	M_H	w	Z[(1)] max.
mm	5.08	0.51	4.0	1.3 0.8	0.53 0.40	0.32 0.23	38.9 38.4	14.0 13.7	1.778	15.24	3.2 2.9	15.80 15.24	17.15 15.90	0.18	1.73

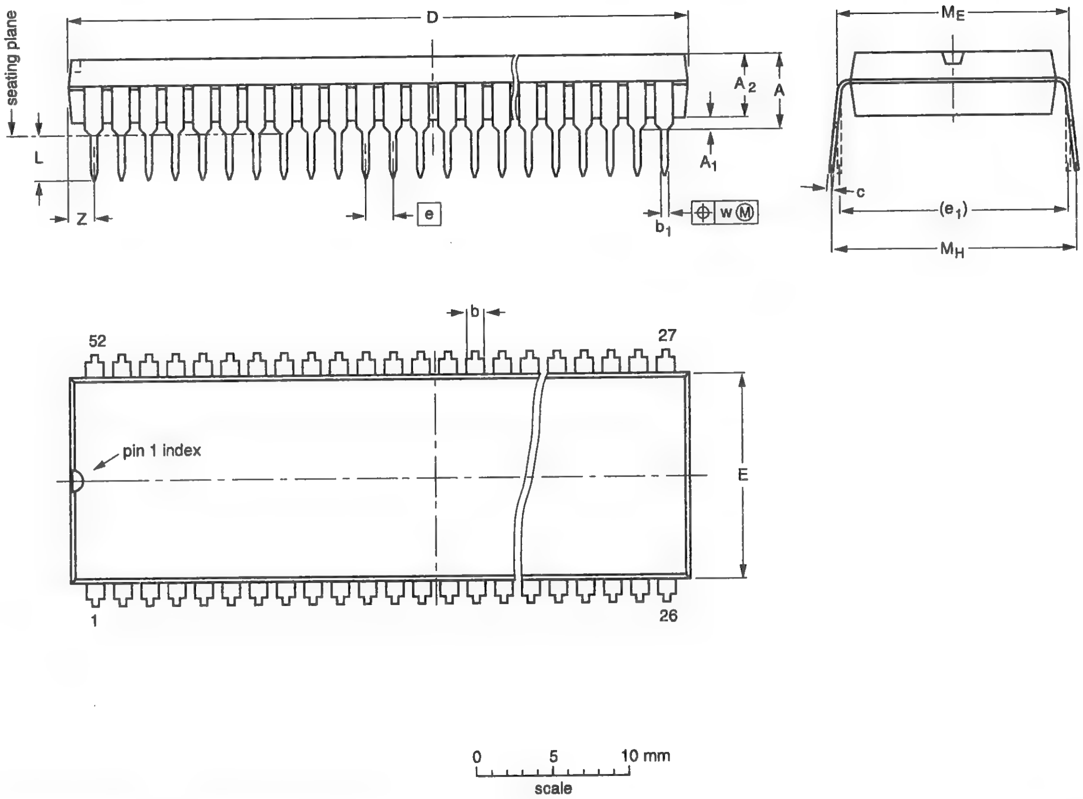
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT270-1						~~90-02-13~~ 95-02-04

SDIP52: plastic shrink dual in-line package; 52 leads (600 mil)

SOT247-1



DIMENSIONS (mm are the original dimensions)

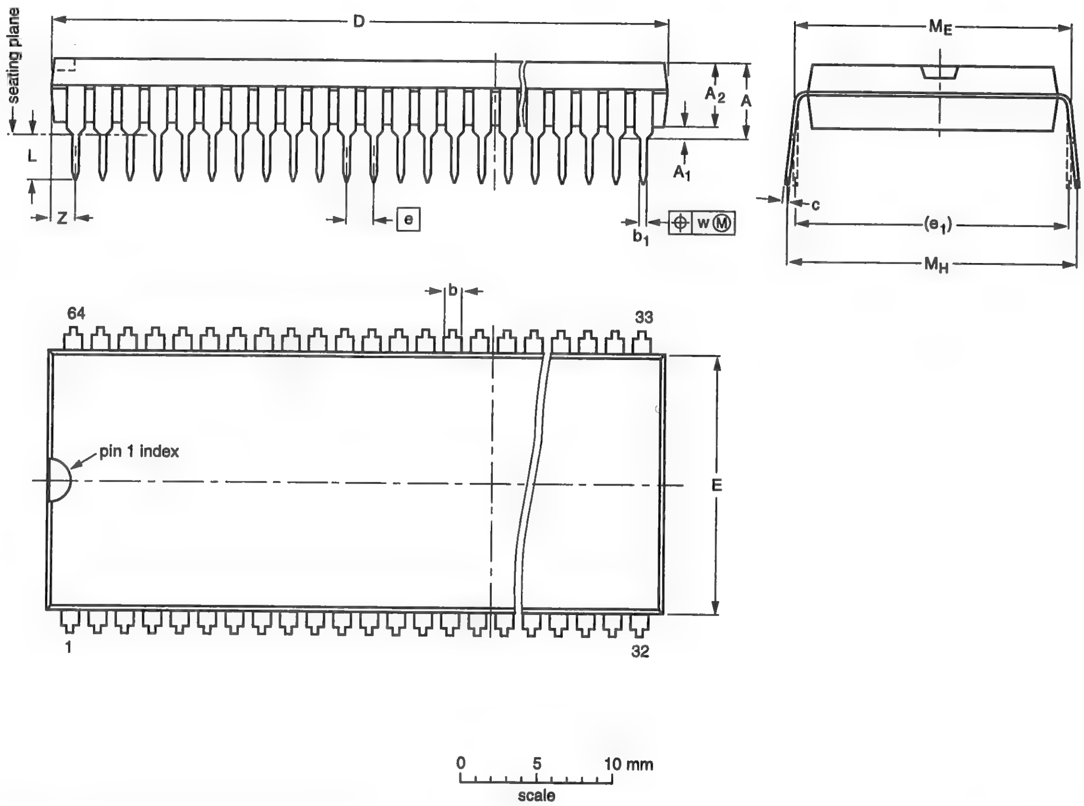
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.08	0.51	4.0	1.3 0.8	0.53 0.40	0.32 0.23	47.9 47.1	14.0 13.7	1.778	15.24	3.2 2.8	15.80 15.24	17.15 15.90	0.18	1.73

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT247-1						~~90-01-22~~ 95-03-11

SDIP64: plastic shrink dual in-line package; 64 leads (750 mil) **SOT274-1**



DIMENSIONS (mm are the original dimensions)

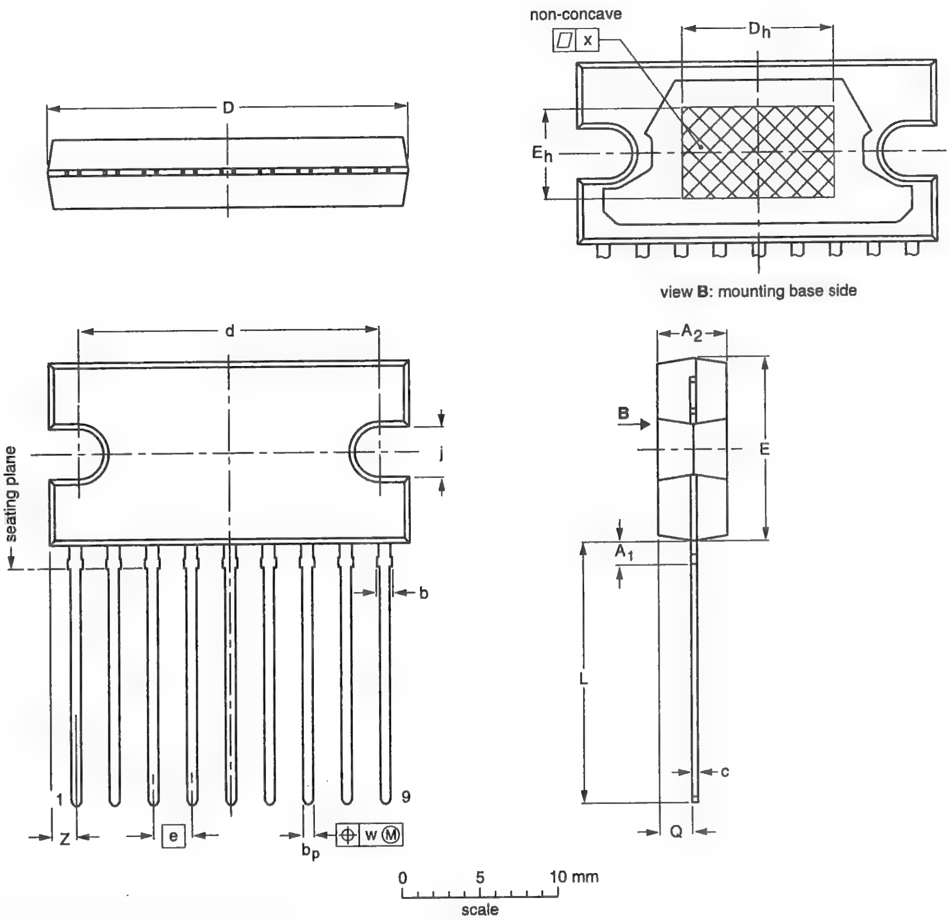
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	5.84	0.51	4.57	1.3 0.8	0.53 0.40	0.32 0.23	58.67 57.70	17.2 16.9	1.778	19.05	3.2 2.8	19.61 19.05	20.96 19.71	0.18	1.73

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT274-1						~~92-10-13~~ 95-02-04

SIL9P: plastic single in-line power package; 9 leads **SOT131-2**



DIMENSIONS (mm are the original dimensions)

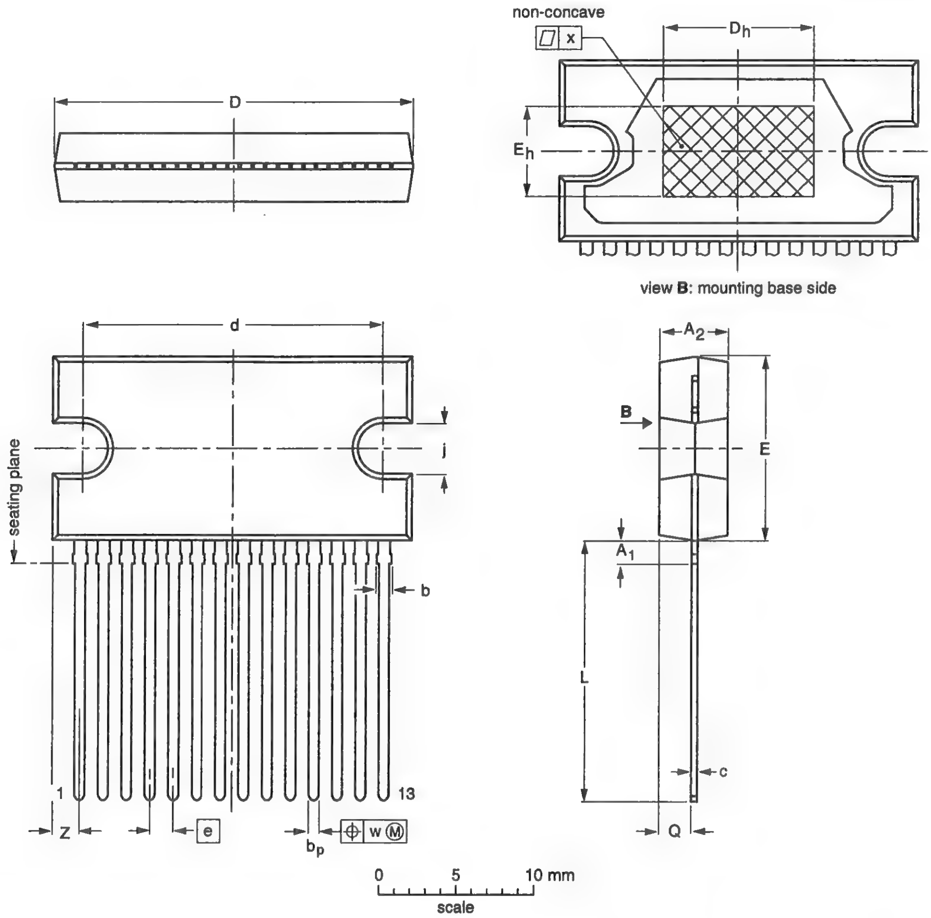
UNIT	A_1 max.	A_2	b max.	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	E_h	j	L	Q	w	x	$Z^{(1)}$
mm	2.0	4.6 4.2	1.1	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	6	3.4 3.1	17.2 16.5	2.1 1.8	0.25	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT131-2						~~92-11-17~~ 95-03-11

SIL13P: plastic single in-line power package; 13 leads **SOT193-2**



DIMENSIONS (mm are the original dimensions)

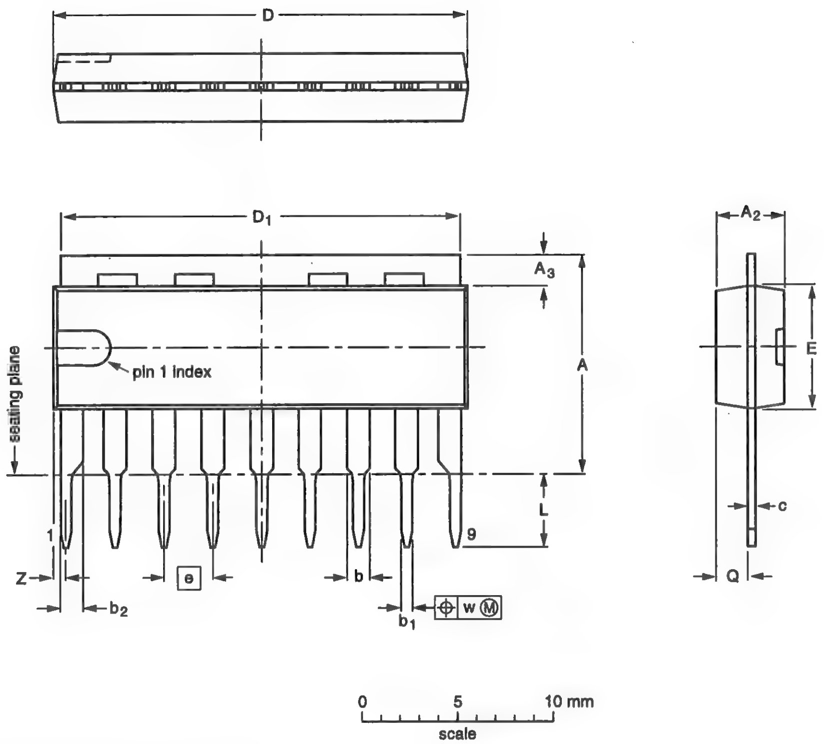
UNIT	A_1 max.	A_2	b max.	b_p	c	D(1)	d	D_h	E(1)	e	E_h	j	L	Q	w	x	Z(1)
mm	2.0	4.6 4.2	1.1	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	6	3.4 3.1	17.2 16.5	2.1 1.8	0.25	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT193-2						~~92-11-17~~ 95-03-11

SIL9MP: plastic single in-line medium power package; 9 leads **SOT142-1**



DIMENSIONS (mm are the original dimensions)

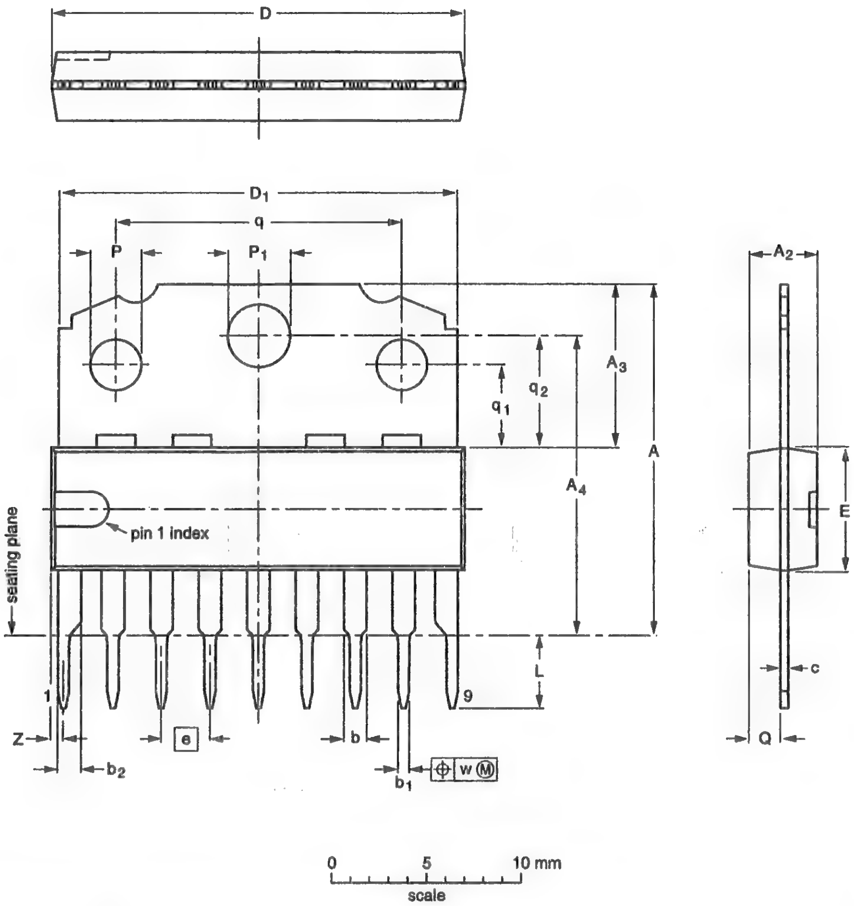
UNIT	A	A_2 max.	A_3	b	b_1	b_2	c	D(1)	D_1	E(1)	e	L	Q	w	Z(1) max.
mm	12 11	3.7	1.8 1.4	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	3.9 3.4	1.75 1.55	0.25	1.0

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT142-1						~~92-11-17~~ 95-02-09

SIL9MPF: plastic single in-line medium power package with fin; 9 leads **SOT110-1**



DIMENSIONS (mm are the original dimensions)

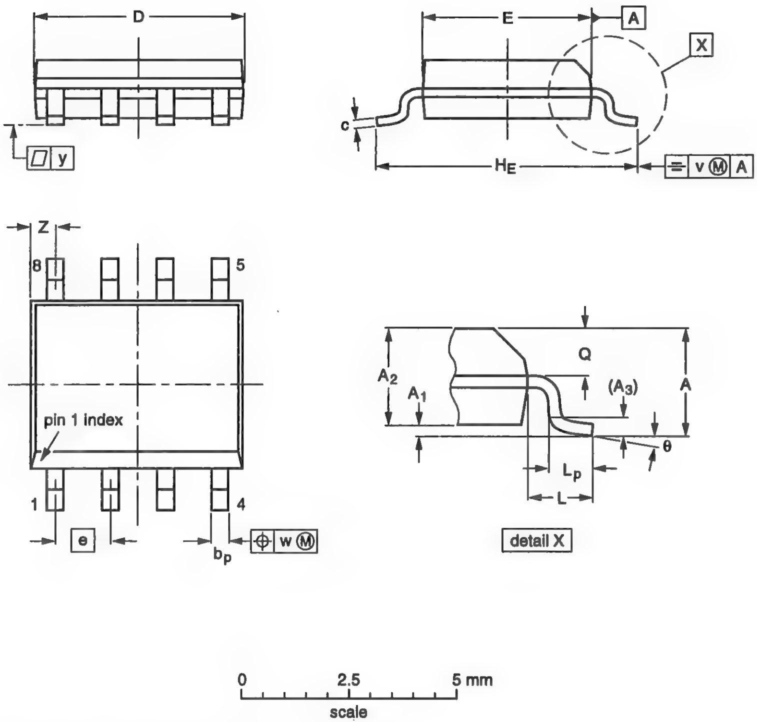
UNIT	A	A_2 max.	A_3	A_4	b	b_1	b_2	c	$D^{(1)}$	D_1	$E^{(1)}$	e	L	P	P_1	Q	q	q_1	q_2	w	$Z^{(1)}$ max.
mm	18.5 17.8	3.7	8.7 8.0	15.8 15.4	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	3.9 3.4	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.25	1.0

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT110-1						~~92-11-17~~ 95-02-25

SO8: plastic small outline package; 8 leads; body width 3.9 mm **SOT96-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.20 0.19	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

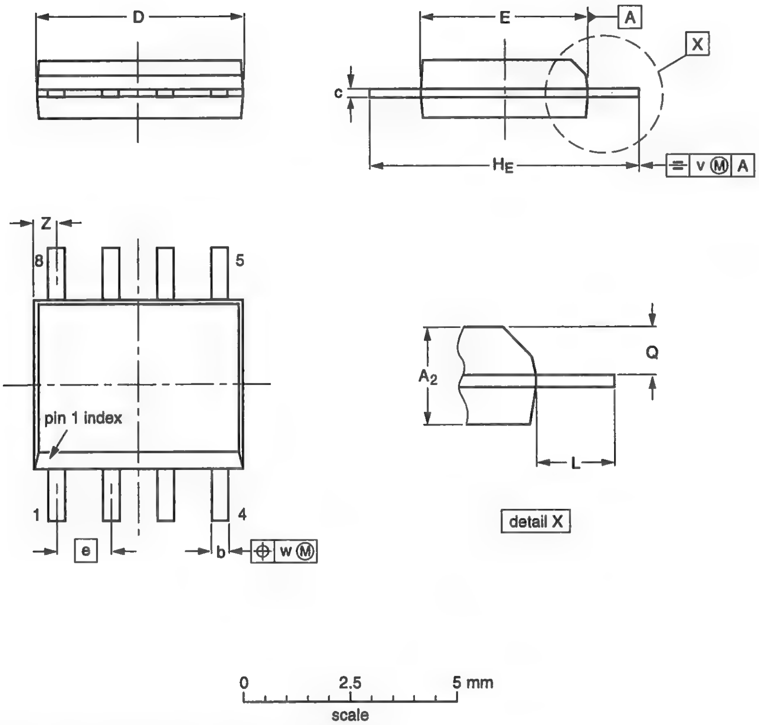
Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03S	MS-012AA				~~92-11-17~~ 95-02-04

SO8: plastic small outline package; 8 leads (straight); body width 3.9 mm

SOT96-2



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A_2	b	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	Q	v	w	$Z^{(1)}$
mm	1.45 1.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.4 6.2	1.2	0.7 0.6	0.25	0.25	0.7 0.3
inches	0.057 0.049	0.019 0.014	0.0098 0.0075	0.20 0.19	0.16 0.15	0.050	0.025 0.024	0.047	0.028 0.024	0.01	0.01	0.028 0.012

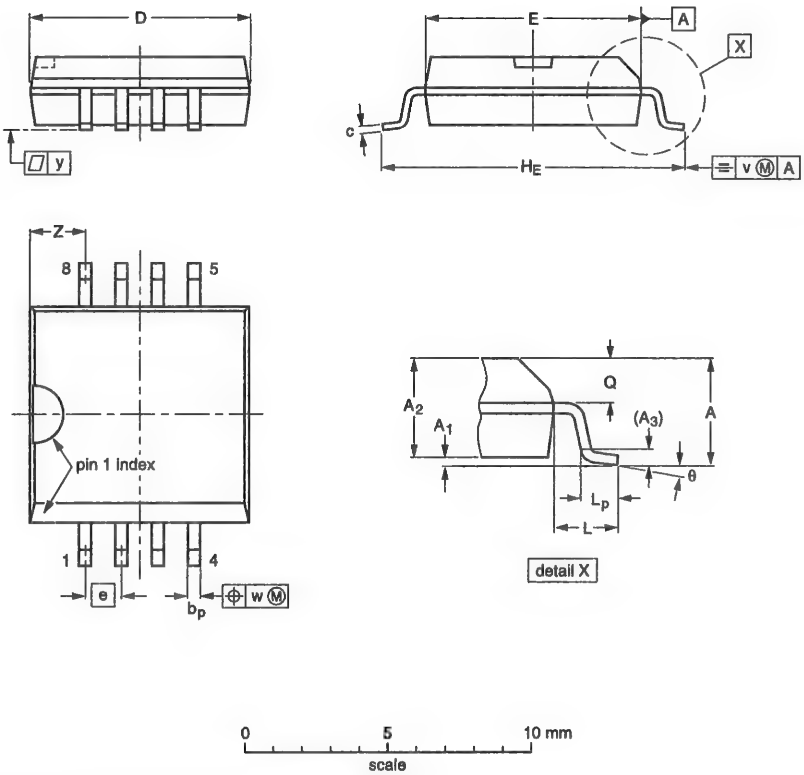
Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-2						~~92-11-17~~ 95-02-04

SO8: plastic small outline package; 8 leads; body width 7.5 mm

SOT176-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	7.65 7.45	7.6 7.4	1.27	10.65 10.00	1.45	1.1 0.45	1.1 1.0	0.25	0.25	0.1	2.0 1.8	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.30 0.29	0.30 0.29	0.050	0.42 0.39	0.057	0.043 0.018	0.043 0.039	0.01	0.01	0.004	0.079 0.071	

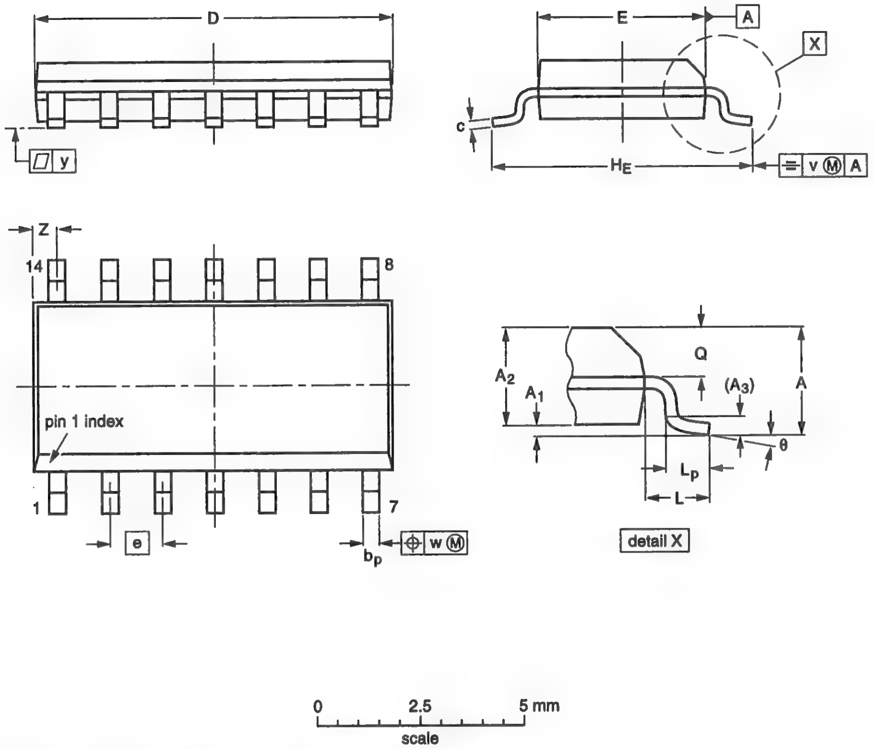
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT176-1						~~91-08-13~~ 95-02-25

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

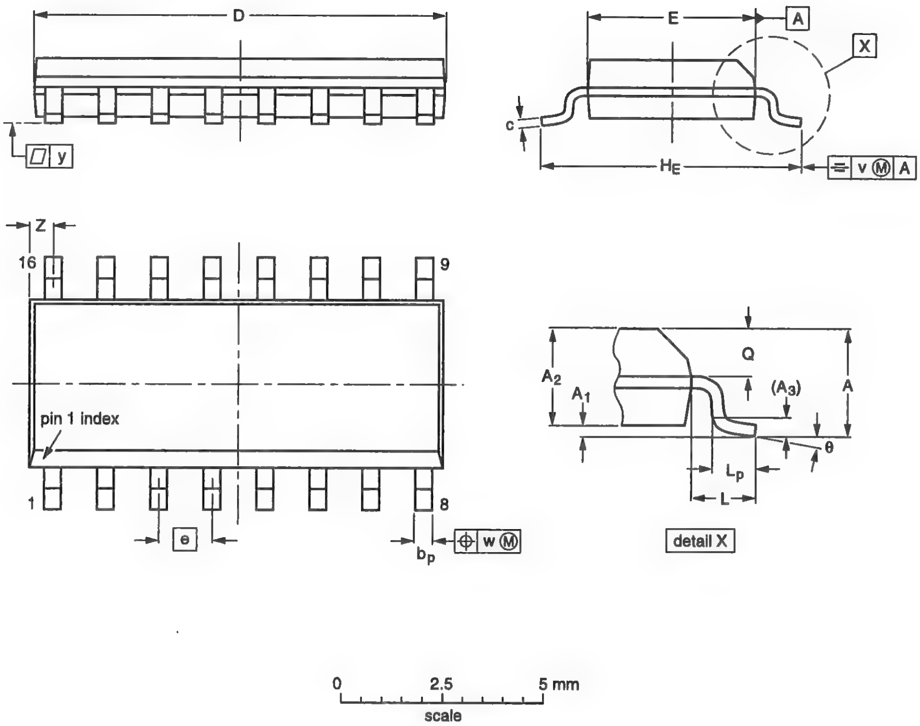
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.35 0.34	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT108-1	076E06S	MS-012AB				~~91-08-13~~ 95-01-23

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

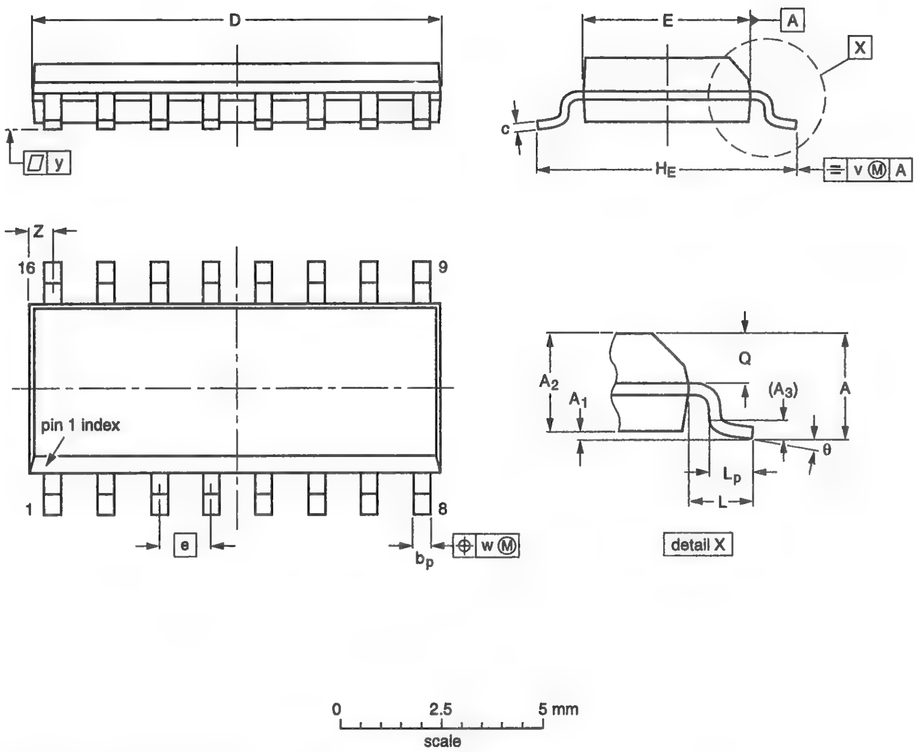
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				~~91-08-13~~ 95-01-23

SO16: plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height **SOT109-2**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

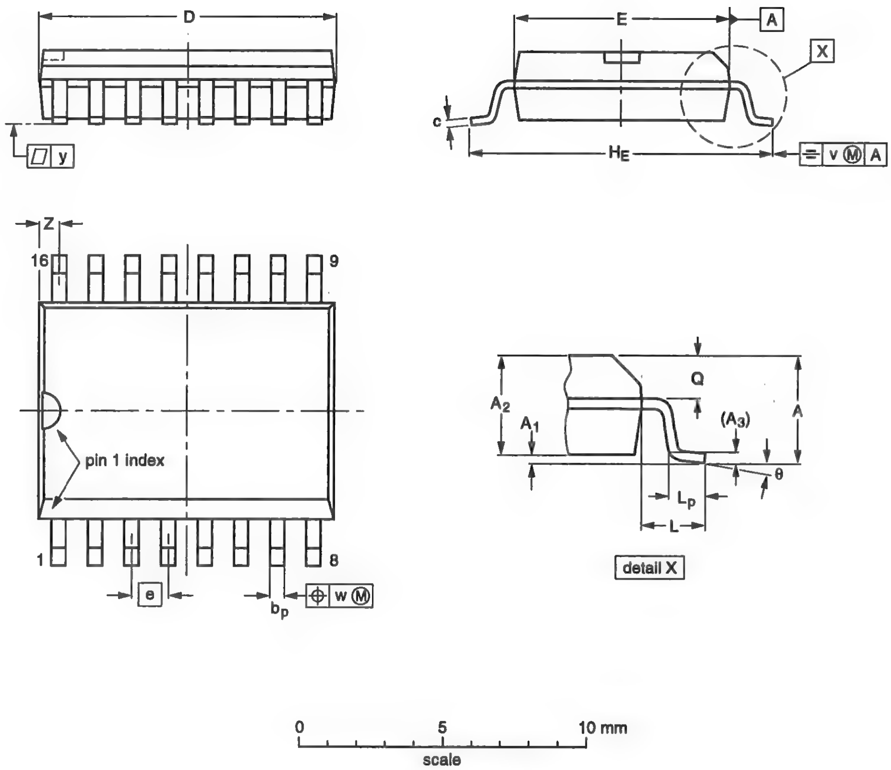
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	1.65	0.20 0.05	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.065	0.0078 0.0020	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-2						~~91-08-13~~ 95-01-23

SO16: plastic small outline package; 16 leads; body width 7.5 mm — SOT162-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

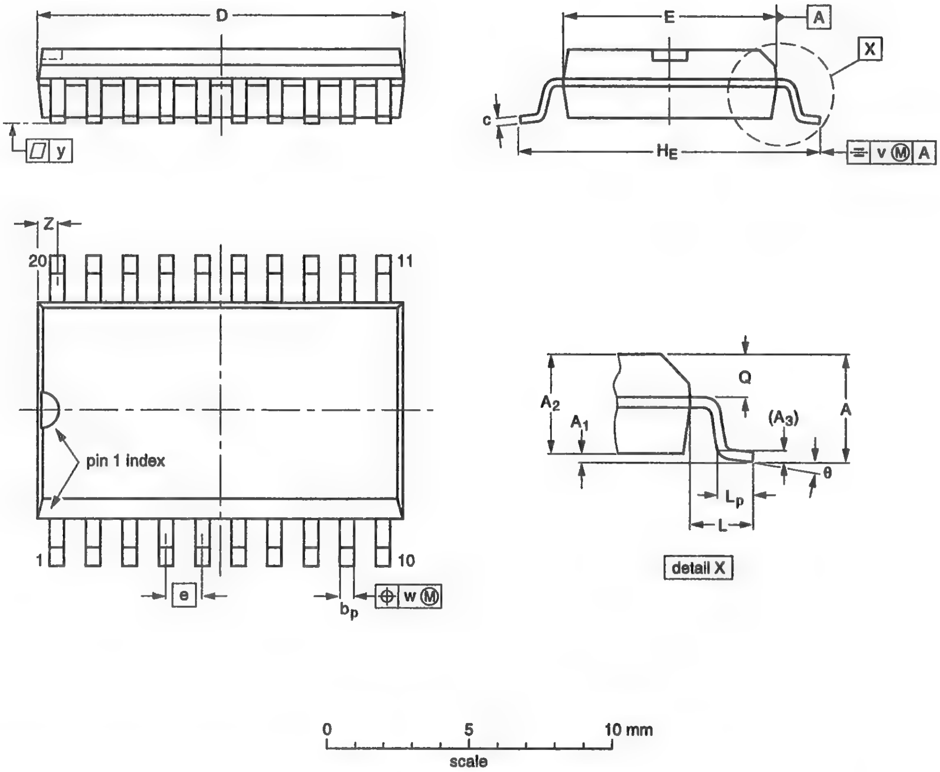
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	10.5 10.1	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.41 0.40	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT162-1	075E03	MS-013AA				~~92-11-17~~ 95-01-24

SO20: plastic small outline package; 20 leads; body width 7.5 mm SOT163-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

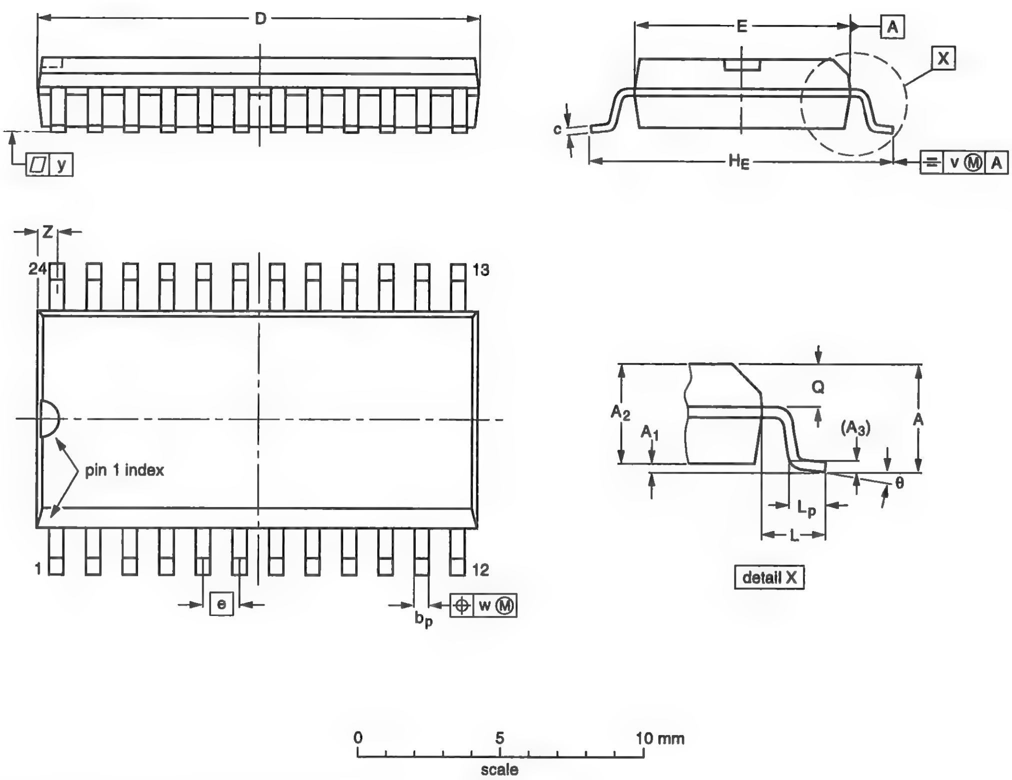
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013AC				~~92-11-17~~ 95-01-24

SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

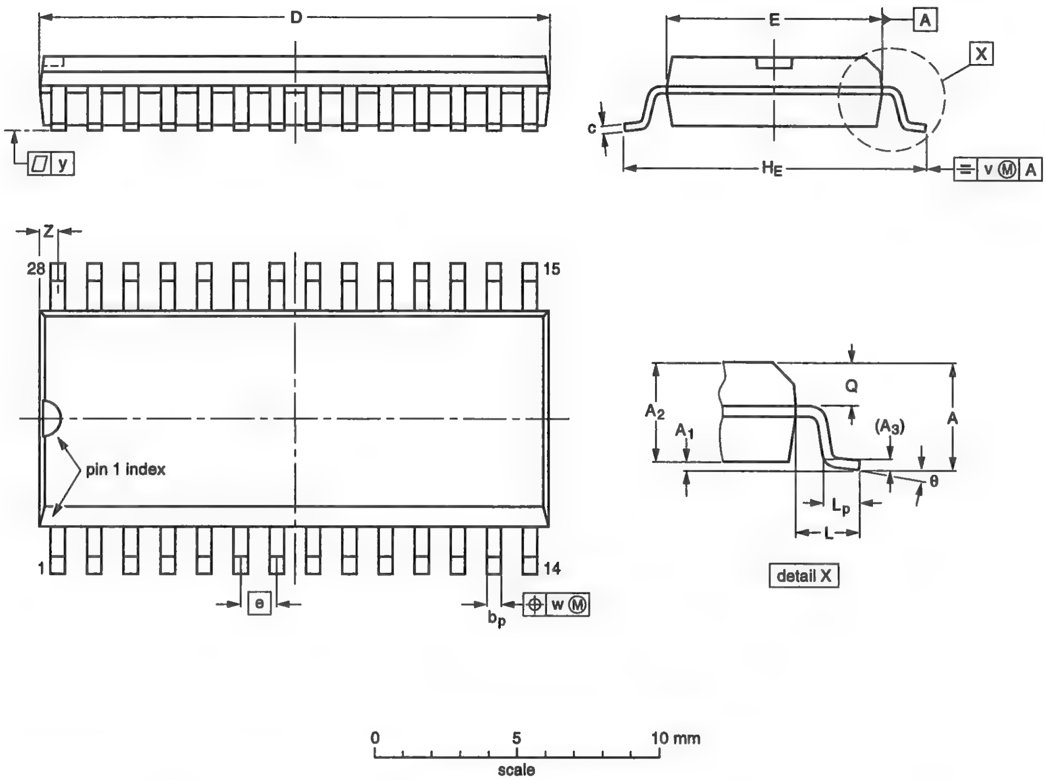
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT137-1	075E05	MS-013AD				~~92-11-17~~ 95-01-24

SO28: plastic small outline package; 28 leads; body width 7.5 mm

SOT136-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	18.1 17.7	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.71 0.69	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

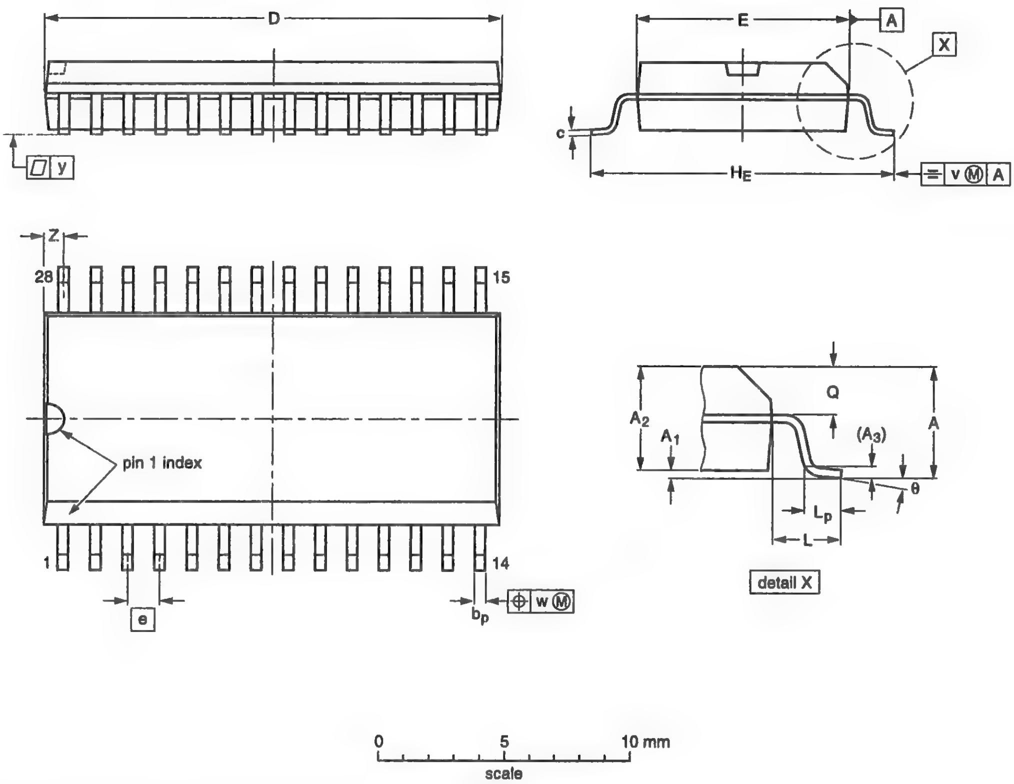
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT136-1	075E06	MS-013AE				~~91-08-13~~ 95-01-24

SO28: plastic small outline package; 28 leads; body width 8.4 mm

SOT213-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

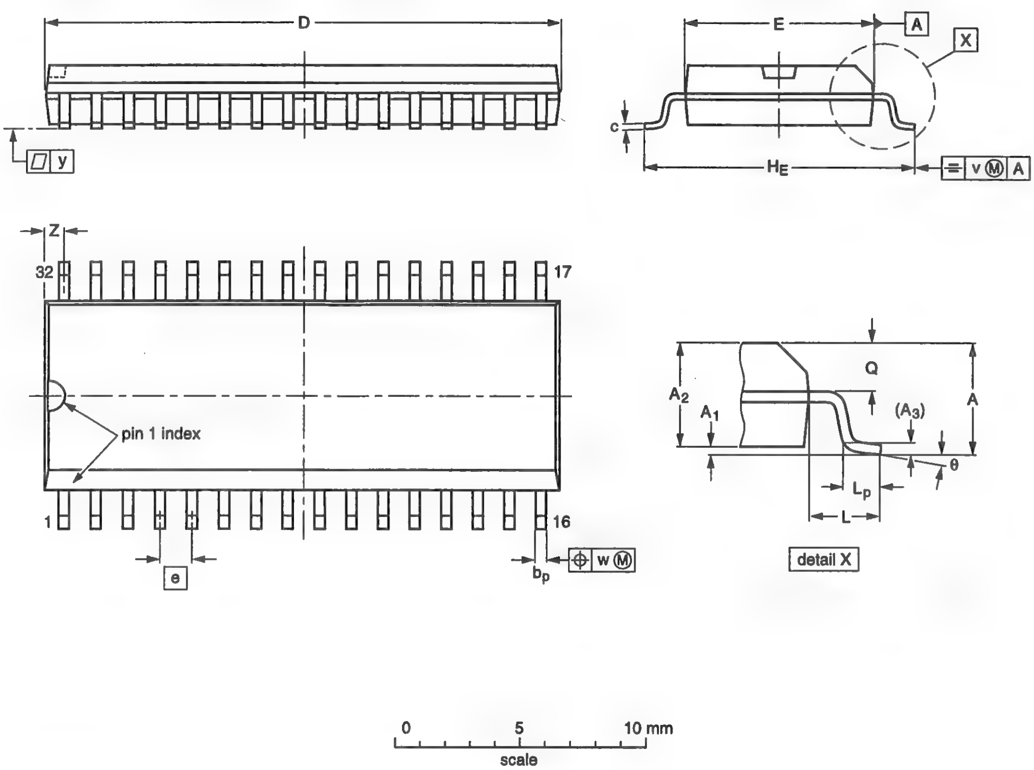
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	3.05	0.3 0.1	2.8 2.6	0.25	0.49 0.36	0.25 0.15	18.2 17.8	8.5 8.3	1.27	12.1 11.5	1.7	1.3 0.7	1.3 1.2	0.25	0.25	0.1	0.95 0.55	8° 0°
inches	0.12	0.012 0.004	0.11 0.10	0.01	0.019 0.014	0.0098 0.0059	0.72 0.70	0.34 0.33	0.05	0.48 0.53	0.067	0.051 0.028	0.051 0.047	0.01	0.01	0.004	0.037 0.022	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT213-1	121E	MO-059AD				~~92-11-17~~ 95-01-25

SO32: plastic small outline package; 32 leads; body width 7.5 mm — SOT287-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.27 0.18	20.7 20.3	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.2 1.0	0.25	0.25	0.1	0.95 0.55	8° 0°
inches	0.10	0.012 0.004	0.096 0.086	0.01	0.02 0.01	0.011 0.007	0.81 0.80	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.047 0.039	0.01	0.01	0.004	0.037 0.022	

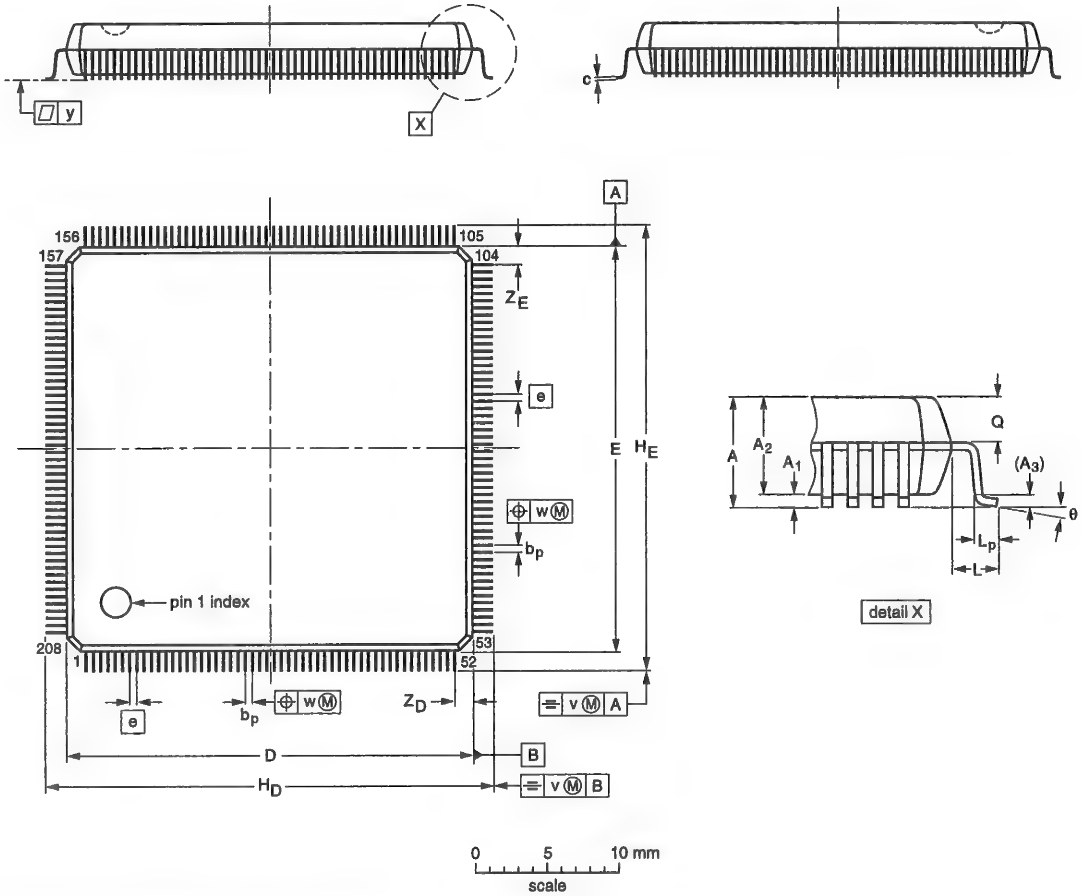
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT287-1						~~92-11-17~~ 95-01-25

SQFP208: plastic shrink quad flat package; 208 leads (lead length 1.95 mm); body 28 x 28 x 3.4 mm

SOT316-1



DIMENSIONS (mm are the original dimensions)

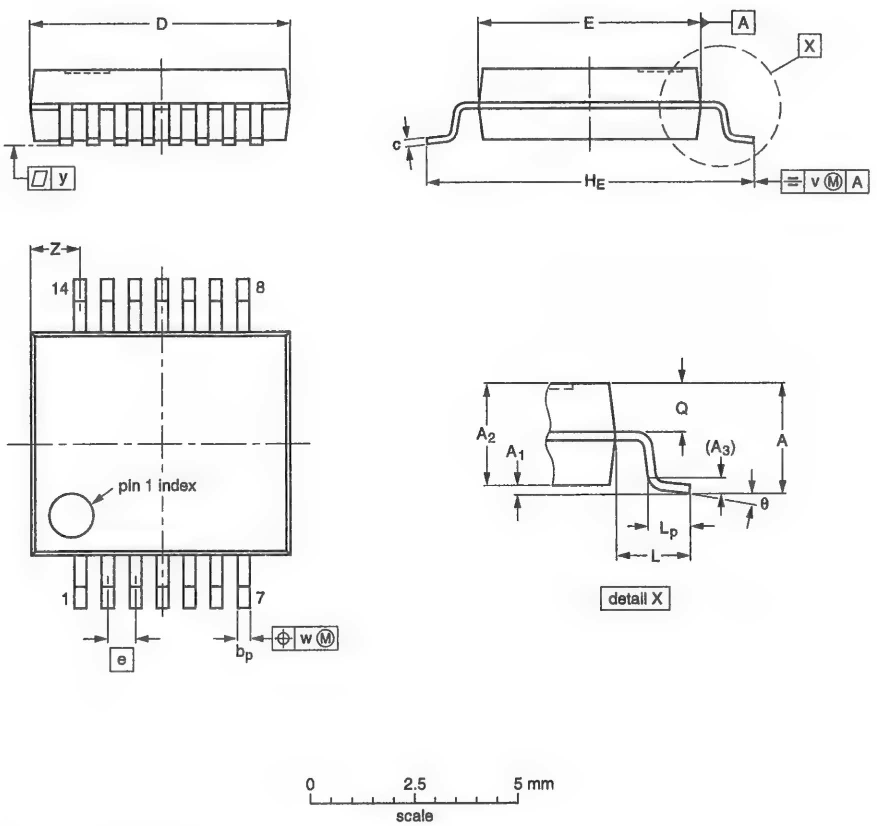
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	Q	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	4.10	0.40 0.25	3.70 3.15	0.25	0.25 0.13	0.23 0.13	28.1 27.9	28.1 27.9	0.5	30.9 30.3	30.9 30.3	1.3	0.70 0.45	1.70 1.55	0.1	0.1	0.075	1.45 1.05	1.45 1.05	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT316-1						~~93-08-23~~ 95-02-04

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm **SOT337-1**



DIMENSIONS (mm are the original dimensions)

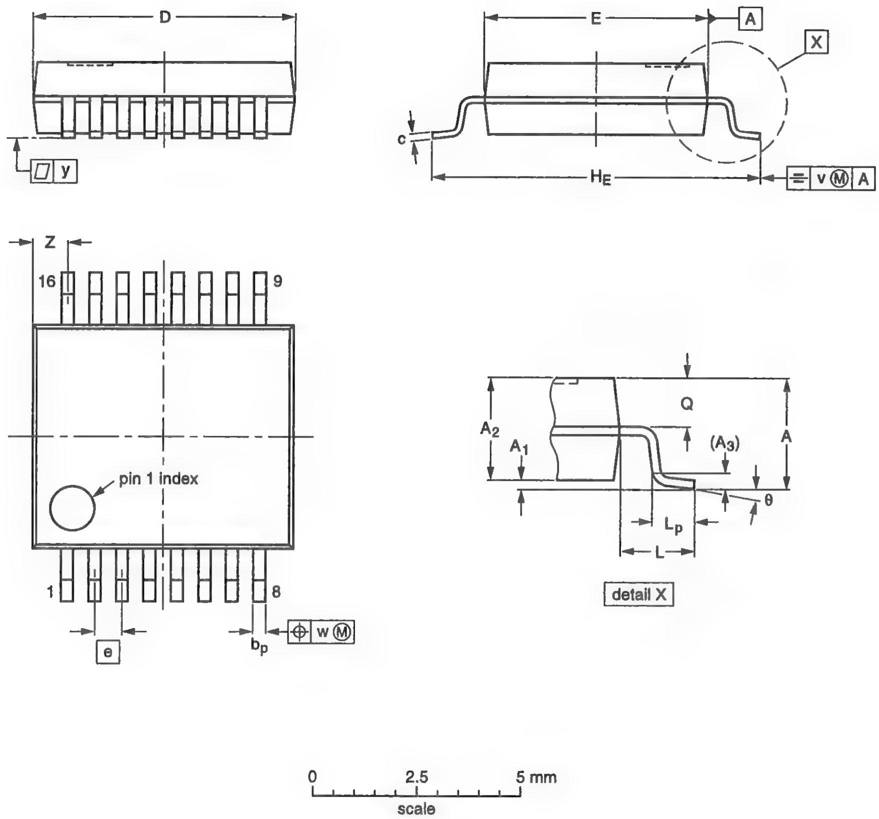
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT337-1		MO-150AB				~~94-01-14~~ 95-02-04

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm — SOT338-1



DIMENSIONS (mm are the original dimensions)

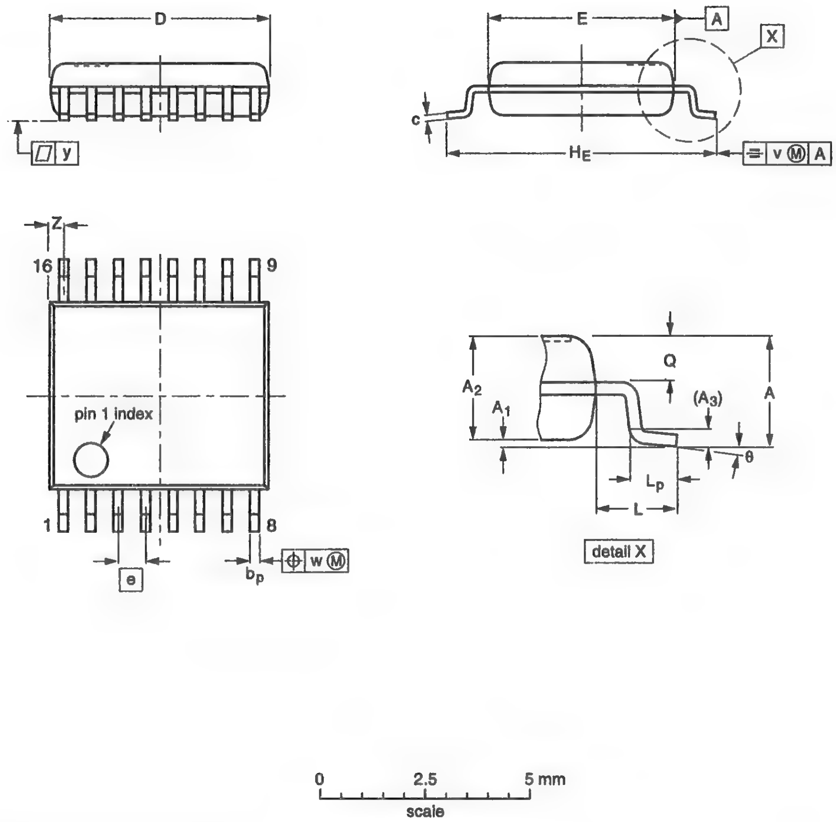
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.00 0.55	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT338-1		MO-150AC				~~94-01-14~~ 95-02-04

SSOP16: plastic shrink small outline package; 16 leads; body width 4.4 mm **SOT369-1**



DIMENSIONS (mm are the original dimensions)

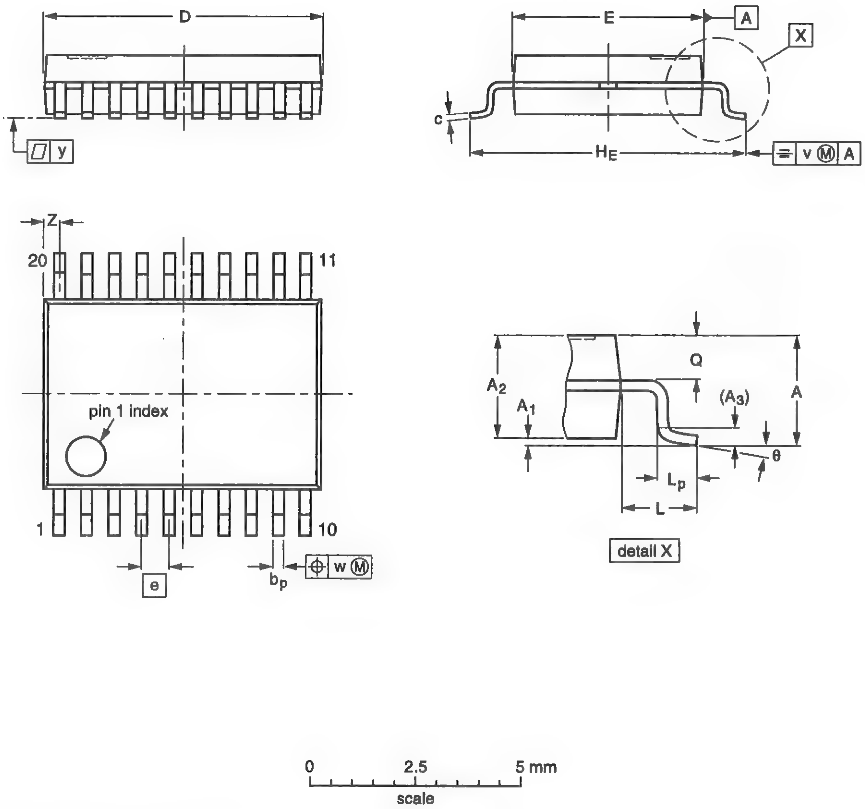
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.5	0.15 0.00	1.4 1.2	0.25	0.32 0.20	0.25 0.13	5.30 5.10	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT369-1						~~94-04-20~~ 95-02-04

SSOP20: plastic shrink small outline package; 20 leads; body width 4.4 mm — SOT266-1



DIMENSIONS (mm are the original dimensions)

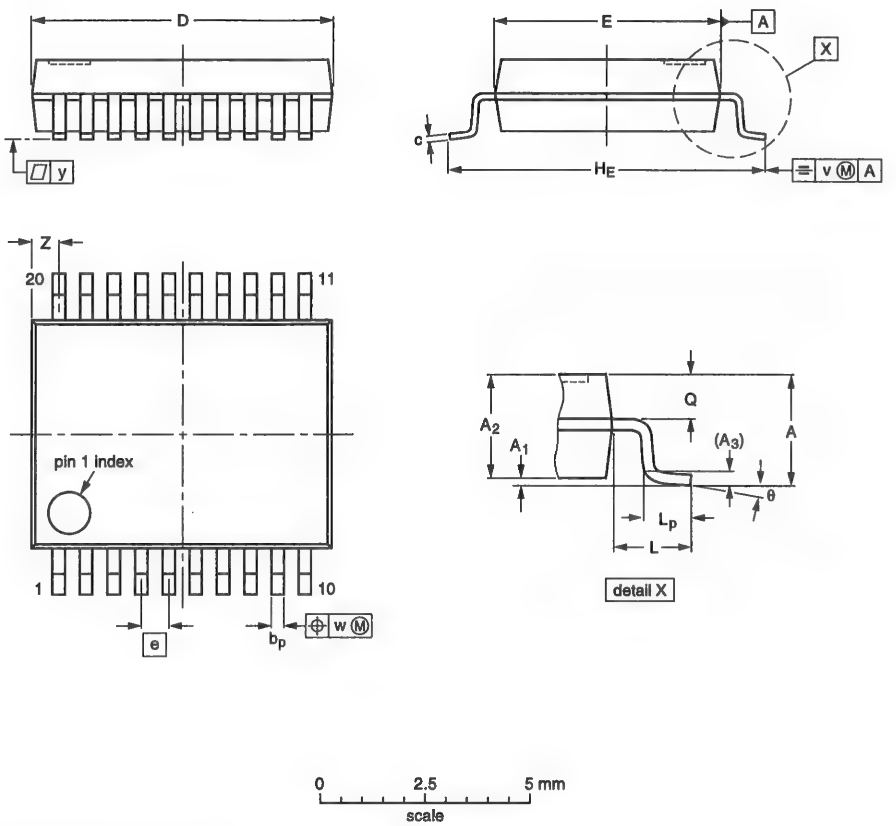
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.5	0.15 0	1.4 1.2	0.25	0.32 0.20	0.20 0.13	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES					EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ				
SOT266-1							~~90-04-05~~ 95-02-25

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm **SOT339-1**



DIMENSIONS (mm are the original dimensions)

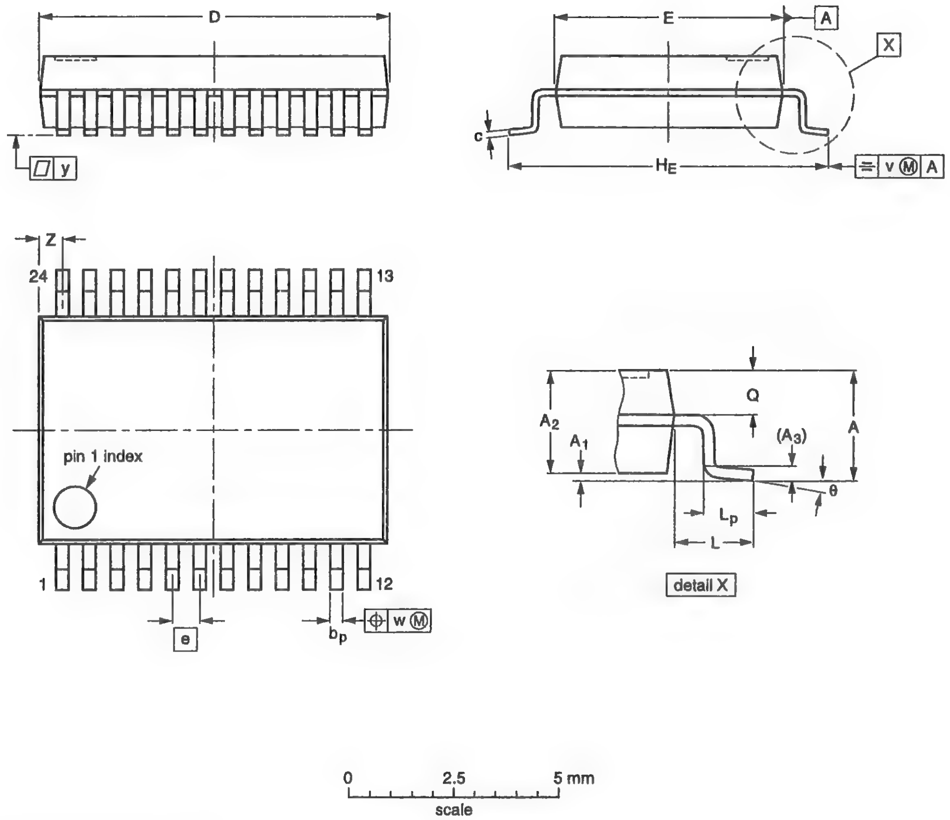
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT339-1		MO-150AE				~~93-09-08~~ 95-02-04

SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm **SOT340-1**



DIMENSIONS (mm are the original dimensions)

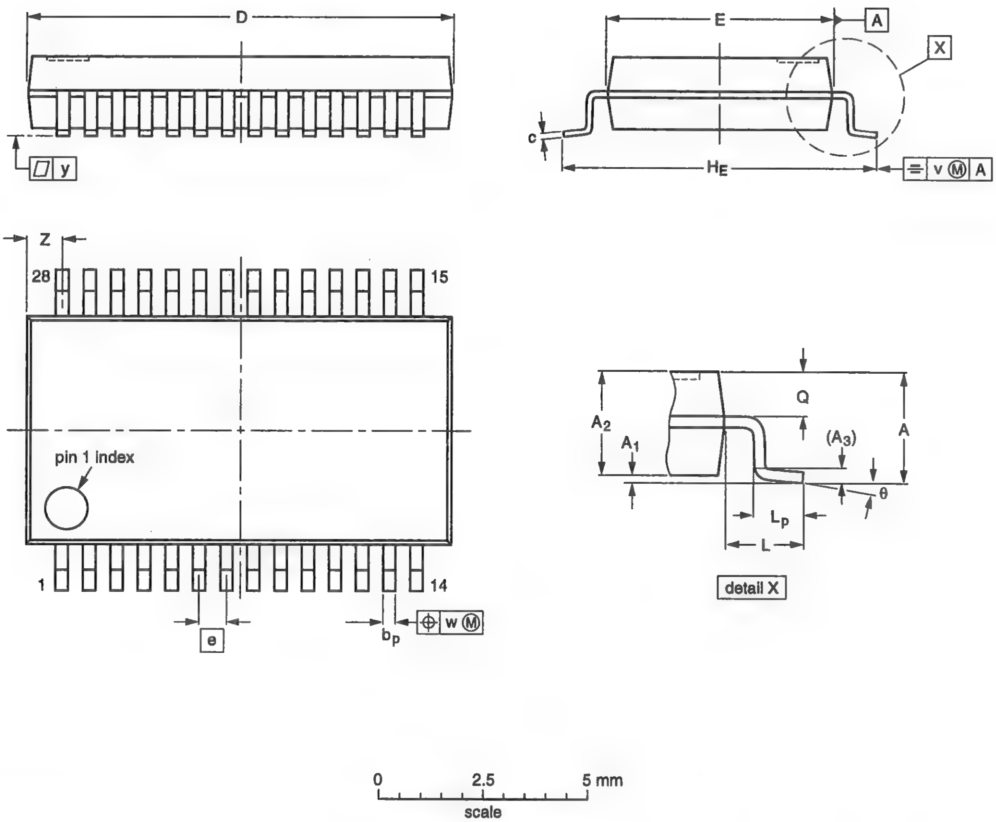
UNIT	A max.	A_1	A_2	A_3	b_p	c	D[(1)]	E[(1)]	e	H_E	L	L_p	Q	v	w	y	Z[(1)]	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	8.4 8.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.8 0.4	8° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT340-1		MO-150AG				~~93-09-08~~ 95-02-04

SSOP28: plastic shrink small outline package; 28 leads; body width 5.3 mm **SOT341-1**



DIMENSIONS (mm are the original dimensions)

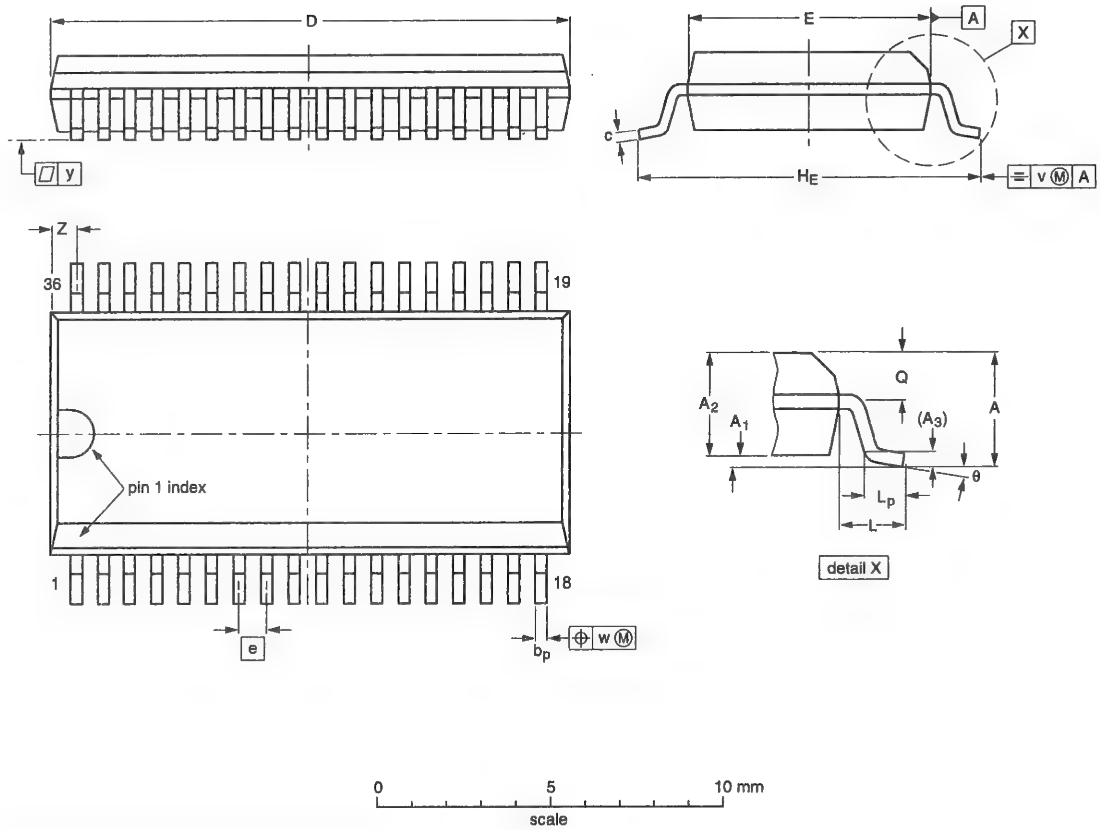
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	10.4 10.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.1 0.7	8° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT341-1		MO-150AH				~~93-09-08~~ 95-02-04

SSOP36: plastic shrink small outline package; 36 leads; body width 7.5 mm; lead pitch 0.8 mm **SOT378-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.40 0.33	0.32 0.23	15.60 15.20	7.60 7.40	0.80	10.60 10.26	1.5	1.10 0.70	1.1 1.0	0.25	0.25	0.1	1.02 0.71	8° 0°

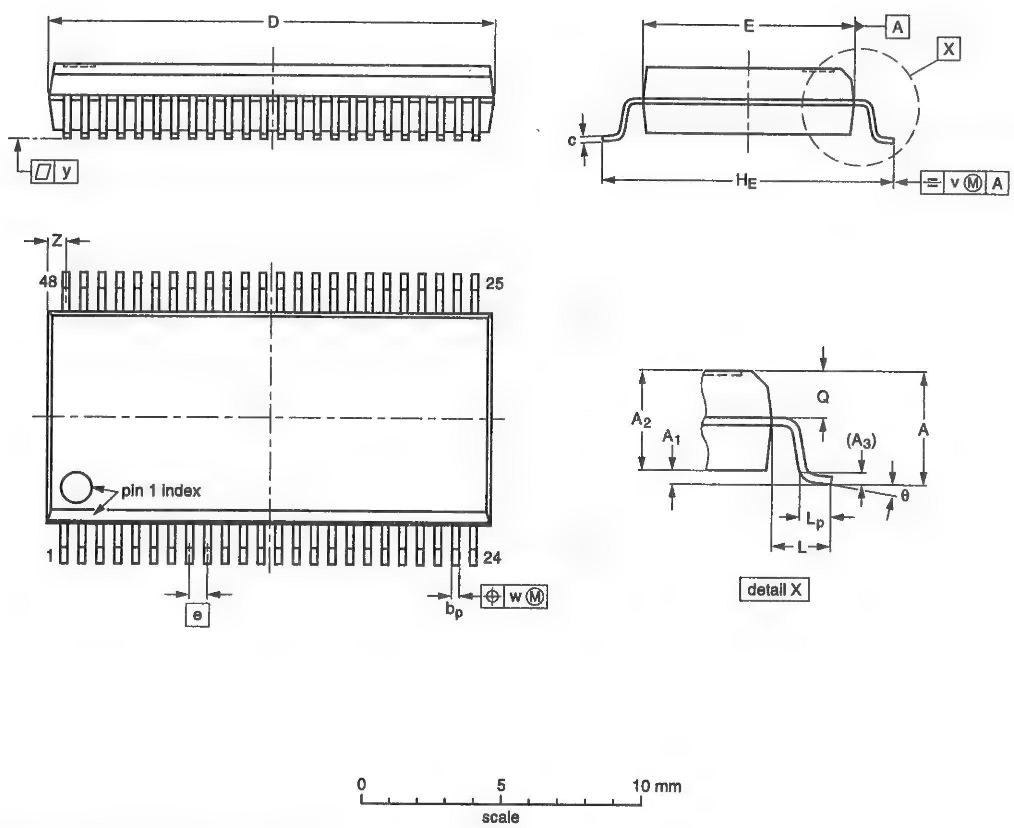
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT378-1			ED-7402-2			95-02-25

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm

SOT370-1



DIMENSIONS (mm are the original dimensions)

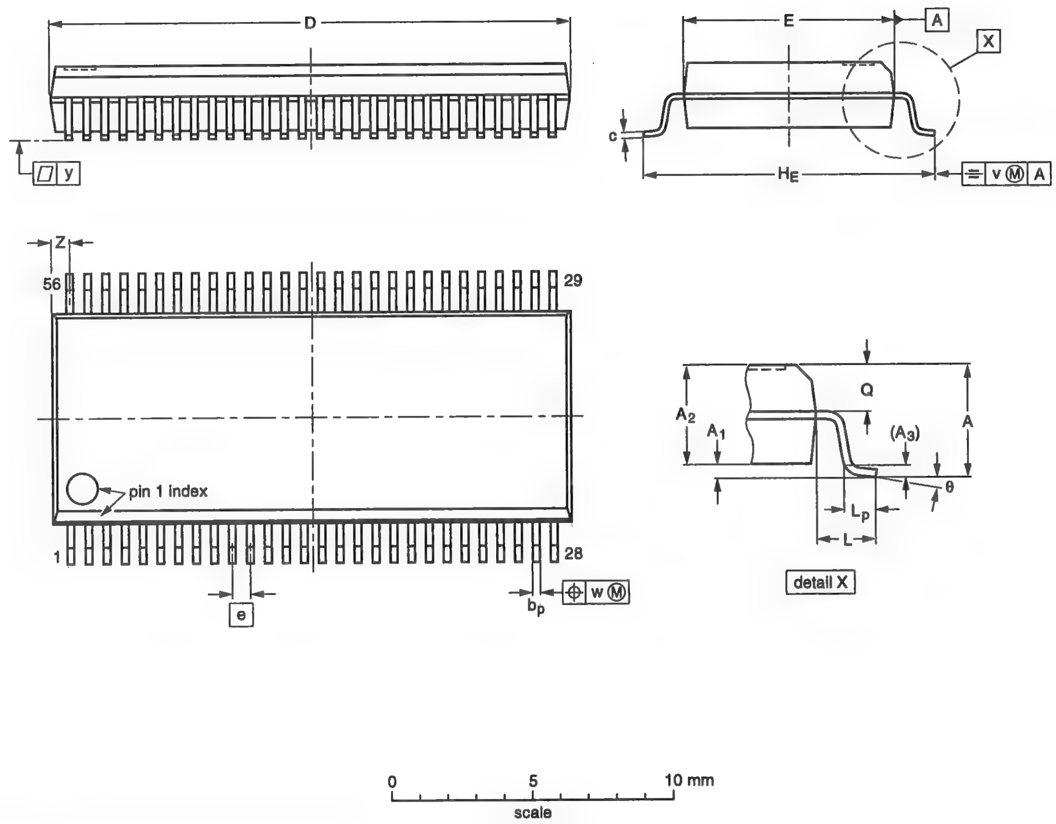
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	16.00 15.75	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT370-1		MO-118AA				~~93-11-02~~ 95-02-04

SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm **SOT371-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	18.55 18.30	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

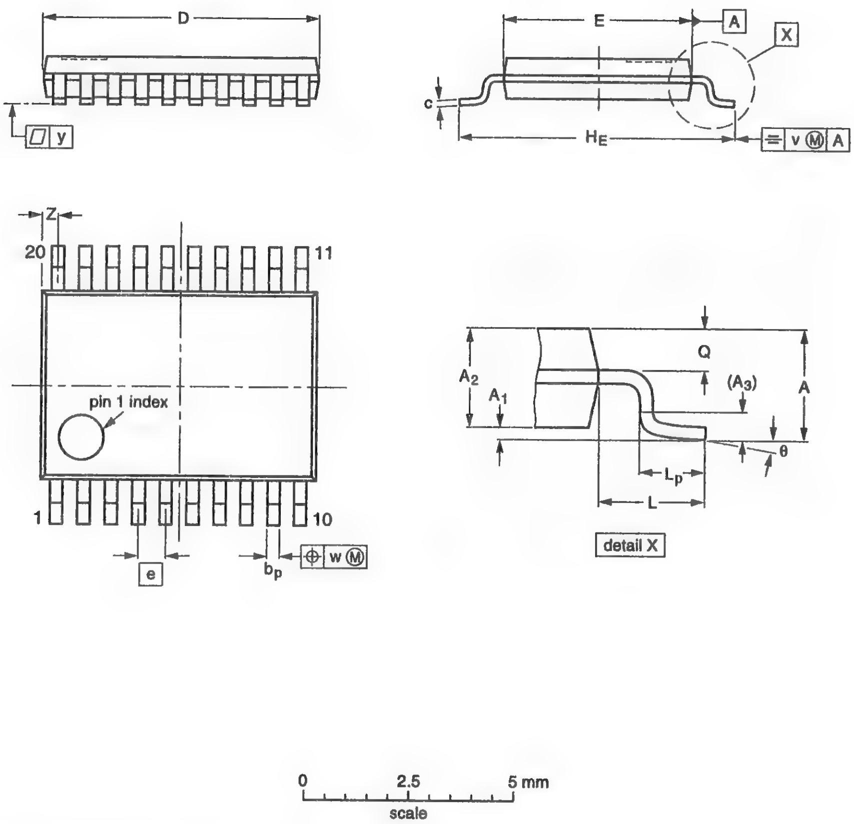
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT371-1		MO-118AB				~~93-11-02~~ 95-02-04

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



DIMENSIONS (mm are the original dimensions)

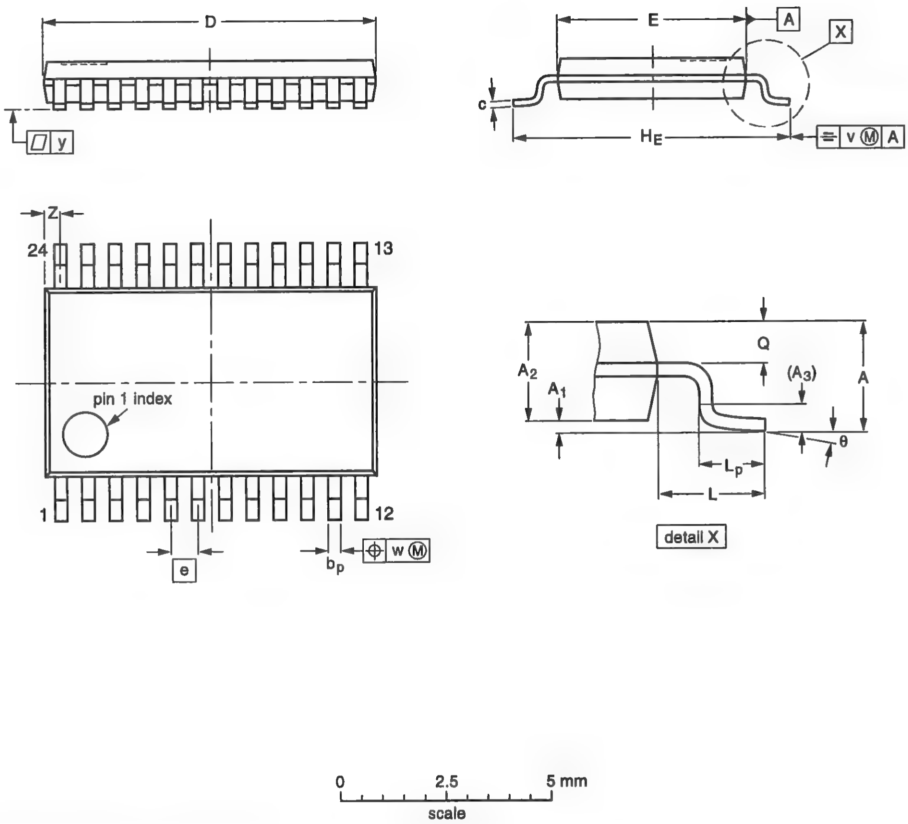
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT360-1		MO-153AC				~~93-06-16~~ 95-02-04

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm **SOT355-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	7.9 7.7	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8° 0°

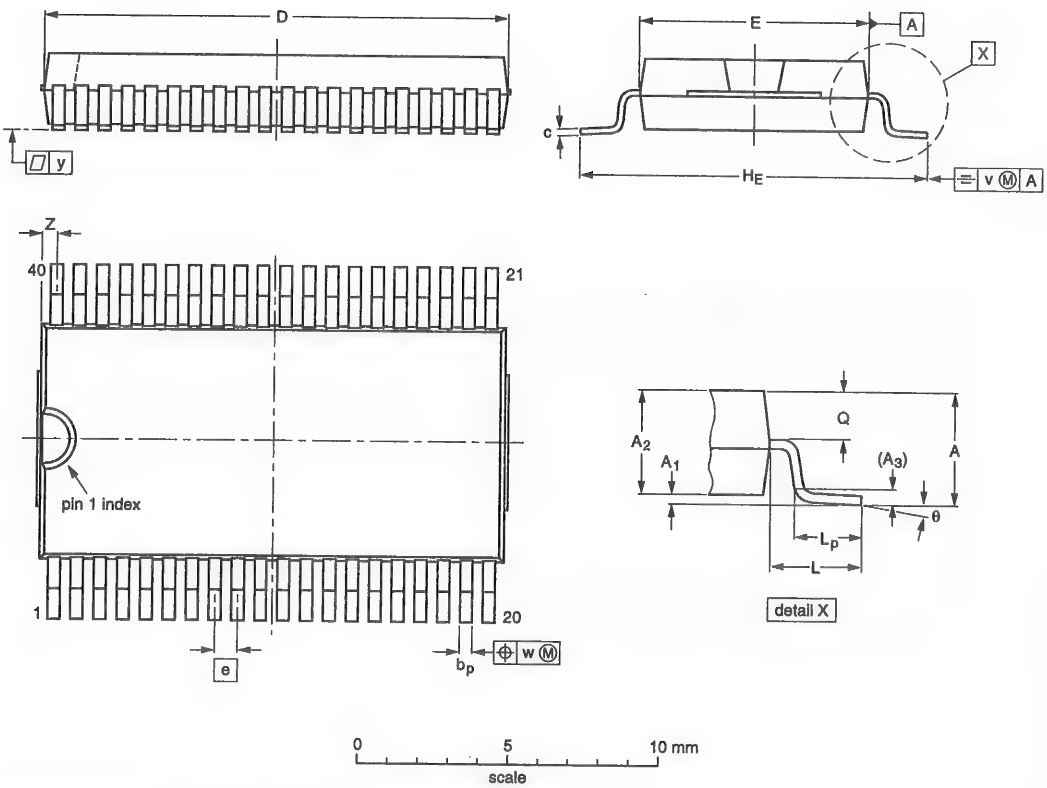
Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT355-1		MO-153AD				~~93-06-16~~ 95-02-04

VSO40: plastic very small outline package; 40 leads

SOT158-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.70	0.3 0.1	2.45 2.25	0.25	0.42 0.30	0.22 0.14	15.6 15.2	7.6 7.5	0.762	12.3 11.8	2.25	1.7 1.5	1.15 1.05	0.2	0.1	0.1	0.6 0.3	7° 0°
inches	0.11	0.012 0.004	0.096 0.089	0.010	0.017 0.012	0.0087 0.0055	0.61 0.60	0.30 0.29	0.03	0.48 0.46	0.089	0.067 0.059	0.045 0.041	0.008	0.004	0.004	0.024 0.012	

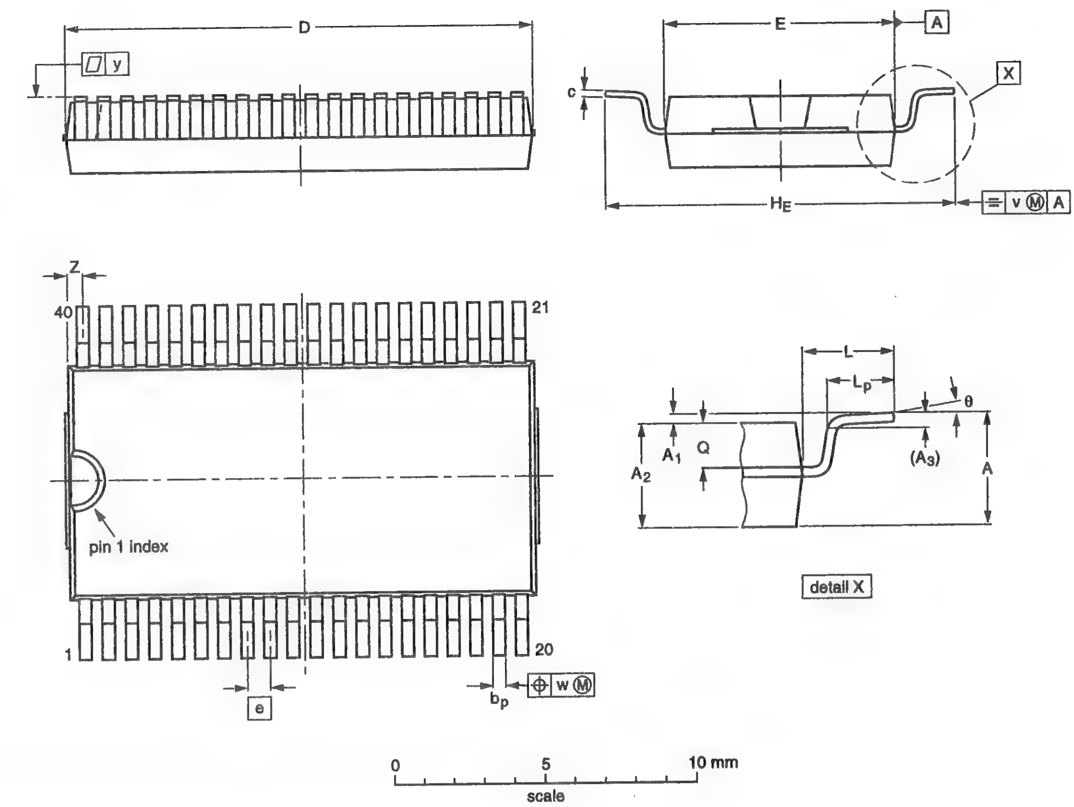
Note

1. Plastic or metal protrusions of 0.4 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT158-1						~~92-11-17~~ 95-01-24

VSO40: plastic very small outline package; 40 leads; face down

SOT158-2



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D[1]	E[2]	e	H_E	L	L_p	Q	v	w	y	Z[1]	θ
mm	2.70	0.3 0.1	2.45 2.25	0.25	0.42 0.30	0.22 0.14	15.6 15.2	7.6 7.5	0.762	12.3 11.8	2.25	1.7 1.5	1.15 1.05	0.2	0.1	0.1	0.6 0.3	7° 0°
inches	0.11	0.012 0.004	0.096 0.089	0.010	0.017 0.012	0.0087 0.0055	0.61 0.60	0.30 0.29	0.03	0.48 0.46	0.089	0.067 0.059	0.045 0.041	0.008	0.004	0.004	0.024 0.012	

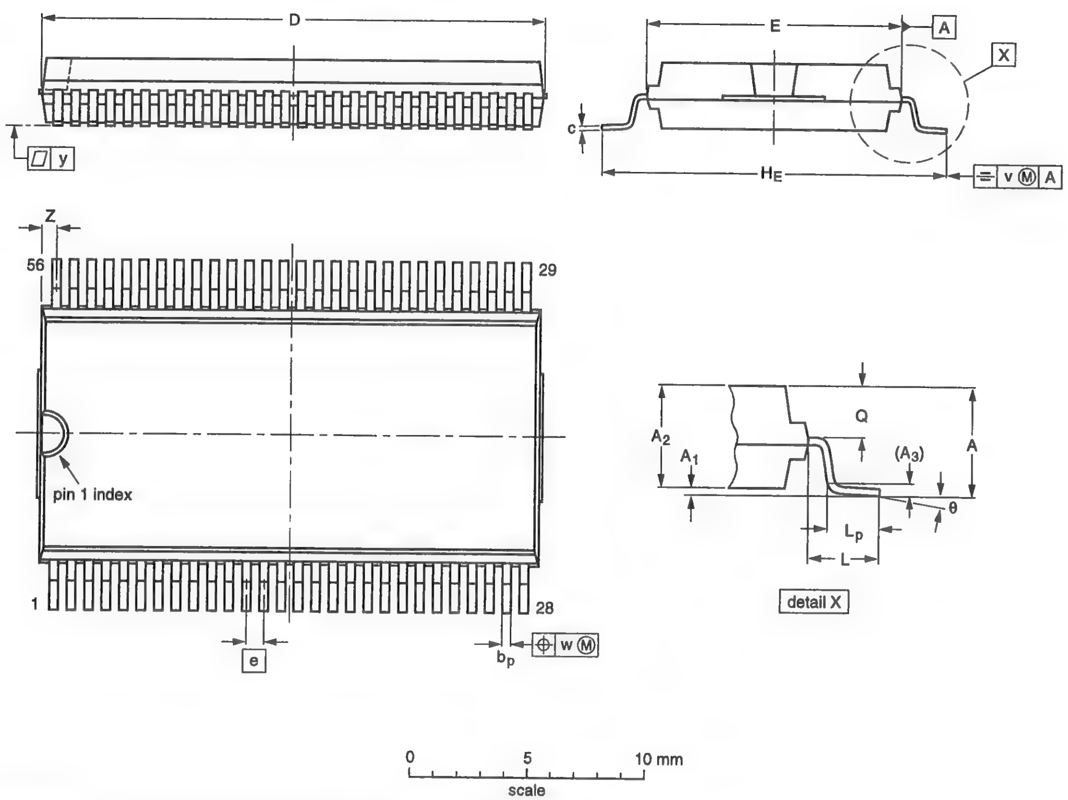
Note

1. Plastic or metal protrusions of 0.4 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT158-2						~~92-11-17~~ 95-01-24

VSO56: plastic very small outline package; 56 leads

SOT190-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(2)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	3.3	0.3 0.1	3.0 2.8	0.25	0.42 0.30	0.22 0.14	21.9 21.5	11.1 11.0	0.75	15.8 15.2	2.25	1.6 1.4	1.45 1.30	0.2	0.1	0.1	0.90 0.55	7° 0°
inches	0.13	0.012 0.004	0.12 0.11	0.01	0.017 0.012	0.0087 0.0085	0.86 0.55	0.44 0.43	0.03	0.62 0.60	0.089	0.063 0.055	0.057 0.051	0.008	0.004	0.004	0.035 0.022	

Note

1. Plastic or metal protrusions of 0.3 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT190-1						~~92-11-17~~ 95-01-24

IC Handling Precautions

ELECTROSTATIC CHARGES

Electrostatic charges can be stored in many things; for example, manmade fibre clothing, moving machinery, objects with air blowing across them, plastic storage bins, sheets of paper stored in plastic envelopes, paper from electrostatic copying machines, and people (Fig.3.1). The charges are caused by friction between two surfaces, at least one of which is non-conductive. The magnitude and polarity of the charges depend on the different affinities for electrons of the two materials rubbing together, the friction force and the humidity of the surrounding air.

Electrostatic discharge is the transfer of an electrostatic charge between bodies at different potentials and occurs with direct contact or when induced by an electrostatic field. All Philips ICs can be damaged if the following precautions are not taken.

WORKSTATION FOR HANDLING MOS ICs

Figure 3.2 shows a working area suitable for safely handling electrostatic-sensitive devices. It has a workbench, the surface of which is conductive and anti-static. The floor should also be covered with anti-static material.

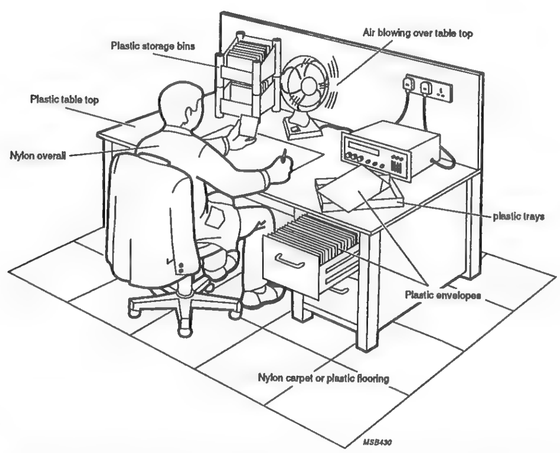


Fig.3.1 Typical working environment for electronic component handling showing potential ESD hazards

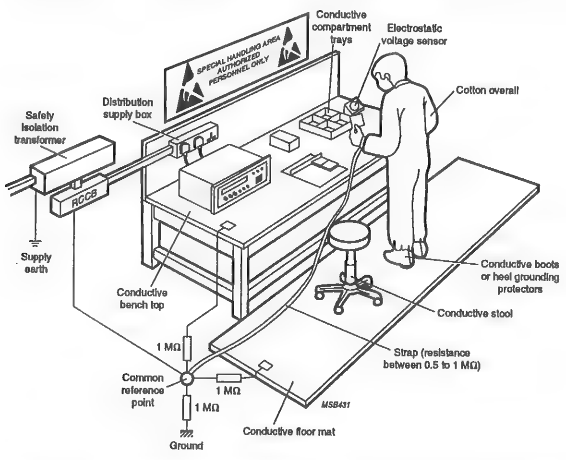


Fig.3.2 Essential features of an ESD-protected work station

The following precautions should be observed:

- Persons at a workbench should be earthed via a wrist strap and a resistor
- All mains-powered equipment should be connected to the mains via an earth-leakage switch
- Equipment cases should be grounded
- Relative humidity should be maintained between 40% and 50%.
- An ionizer should be used to neutralize objects with immobile static charges in case other solutions fail.
- Keep static materials, such as plastic envelopes and plastic trays etc, away from the workbench. If there are any such static materials on the workbench, remove them before handling the ICs.
- Refer to the current version of the handbook EN 100015 (CECC 00015) "Protection of Electrostatic Sensitive Devices", which explains in more detail how to arrange an ESD protective area for handling ESD sensitive devices.

RECEIPT AND STORAGE OF ICs

ICs are packed for despatch in anti-static/conductive containers, usually boxes, tubes or blister tape. Warning labels on both primary and secondary packing show that the contents are sensitive to electrostatic discharge.

The ICs should be kept in their original packing whilst in storage. If a bulk container is partially unpacked, the unpacking should be done at a protected workstation. Any ICs that are stored temporarily should be packed in conductive or anti-static packing or carriers.

PCB ASSEMBLY WITH ICs

ICs must be removed from their protective packing with grounded component-pincers or short-circuit clips. Short-circuit clips must remain in place during mounting, soldering and cleansing/drying processes. Don't remove more ICs from the storage packing than are needed at any one time. Production/assembly documents should state that the product contains electrostatic sensitive devices and that special precautions need to be taken. During assembly, ensure that the ICs are the last of the components to be mounted and that this is done at a protected workstation.

All tools used during assembly, including soldering tools and solder baths, must be grounded. All hand-tools should be of conductive or anti-static material and, where possible, should not be insulated.

TESTING PCBs CONTAINING ICs

Completed PCBs must be tested at a protected workstation. Place the soldered side of the circuit board on conductive or anti-static foam and remove the short-circuit clips. Remove the circuit board from the foam, holding the board only at the edges. Make sure the circuit board doesn't touch the conductive surface of the workbench. After testing, replace the PCB on the conductive foam to await packing.

Assembled circuit boards containing ICs should always be handled in the same way as unmounted ICs. They should also carry warning labels and be packed in conductive or anti-static packing.

SOLDERING THROUGH-HOLE MOUNT PACKAGES

By dipping or by solder wave

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 s. The total contact time of successive solder waves must not exceed 5 s.

The IC may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the PCB has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit. For more information on solder wave methods, refer to Chapter 5.

Repairing soldered joints

Apply the soldering iron to the IC pin(s) below the seating plane, or not more than 2 mm above it. If the temperature of the soldering iron bit is below 300 °C, it may remain in contact for up to 10 s. If it is over 300 °C but below 400 °C, it may only remain in contact for up to 5 s.

Unfortunately, there is no one soldering method ideal for all IC packages. Many manufacturers still use, and will continue to use for some time to come, a mixture of surface-mount and through-hole components and so may prefer the wave soldering method. However, with an ever increasing variety of components becoming available as SMD types, reflow soldering is increasingly in popularity. Table 1 gives an overview of which IC packages are suitable for the various soldering methods.

DOUBLE-WAVE SOLDERING

Although conventional wave soldering can still be used for certain circuits, it is not recommended for soldering SMDs, or PCB with a high component density, as solder bridging and non-wetting can present major problems. The double-wave soldering method, which was specifically developed to overcome such problems, is a much better soldering technique, although even this method is not suitable for ICs with closely-spaced leads.

If wave soldering is used, the following conditions must be observed:

- the PCB footprint must incorporate solder thieves on the downstream end
- the longitudinal axis of the IC must be parallel to the direction of the solder flow.

Suitable PCB footprints for double-wave soldering are given later in this chapter.

Applying adhesive

To prevent movement of the IC packages during wave soldering, it is necessary to bond the IC to the PCB with a high green-strength adhesive (such as thermosetting epoxy resin Heraeus PD860002 SP or Amicon D125) and cure it. The preferred method of applying the adhesive is by syringe since this allows a precisely measured amount of solder to be applied at each position.

Typical curing times for an SMD adhesive are 30 minutes at 85 °C (starting from ambient temperature), or as little as 3 minutes at 125 °C (see Fig.5.1).

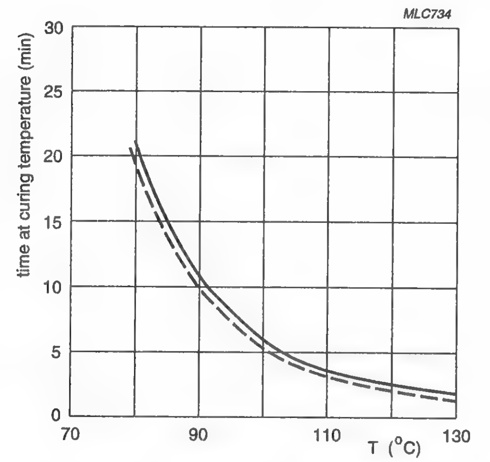


Fig.5.1 Typical curing curve for a thermoset epoxy resin (—— 90% and ---- 80% conversion)

TABLE 1
Suitability of ICs for various soldering methods

	SO	SSOP	VSO	TSSOP	QFP	SQFP	LQFP	TQFP	PLCC
standard	IEC/JEDEC				IEC/JEDEC				JEDEC
Nº of leads	8-32	14-56	40-56	14-36	44-160	128-208	32-80	44-100	20-84
suitability for wave soldering [1]	4	2[2]	3	1[2]	2[2] (at 45°)	1[2]	1[2]	1[2]	3
suitability for reflow soldering [1]									
IR	4	4	3	3	3	3	3	3	2
hot belt	4	4	3	3	3	3	3	3	3
hot gas	4	4	4	3	4	4	4	4	3
vapour phase	4	2	3	2	2	2	2	2	1
resistance	1	1	4	1	4	1	1	1	1
ease of assessing soldered joint quality	good	good	good	good	good	good	good	good	difficult

1) rating from 1 to 4 (1 indicates that soldering is very difficult; 4 that soldering is straightforward)
2) wave soldering is not suitable for certain types, refer to footprint data at the end of this chapter for more details

Positioning the IC on the PCB

ICs are usually positioned on a PCB by placement machine, however, dimensional tolerances of the IC package and PCB, combined with inaccuracy of the placement machine can lead to component misalignment. Total misalignment is expressed as the sum of deviations in the x, y directions (Fig.5.2) and in component rotation with respect to the footprint position ϕ. Small variations in ϕ have large effects on placement accuracy, so the positioning of the leads is crucial for large multi-leaded ICs with a small pitch.

The maximum placement deviations for each IC are given with the footprint design later in this Chapter.

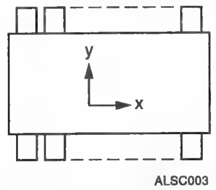


Fig.5.2 Alignment of SO package on the PCB

Double-wave soldering method

After applying adhesive, placing the ICs and curing the adhesive, the areas to be soldered are coated with a thin layer of mildly activated flux, applied by spraying or as a foam. The flux assures good wetting of the soldering surfaces.

The PCB is then preheated to around 85 °C for solvent-based fluxes, or to 115 °C for water-soluble fluxes (temperatures on the solder side of the board). Preheating serves several purposes: it reduces the flux to the required viscosity, it heats the PCB and components to reduce thermal shock and promote faster wetting, and it minimises the time spent at soldering temperature, which prevents dissolution of component metallization (*leaching*).

In a double-wave soldering machine, the solder is applied by moving the inclined PCB across two successive waves of solder. It's important to note that the PCB must be loaded into the machine in such a way that the SMDs on the board come into direct contact with the solder wave (see Fig.5.3).

The PCB first passes over a turbulent wave of solder, which has a high vertical velocity and constant height. This ensures good solder contact with the edges of the IC and prevents joints from being missed. The second, smoother laminar wave of solder completes formation of the solder fillet and reduces bridging. A little activated oil in the second solder wave helps to prevent formation of oxide skins on the surface of the solder, thereby reducing bridging as the PCB leaves the wave.

Typically, the double-wave method uses common solder alloys (such as tin 60/lead 40), a soldering temperature of 250 ± 3 °C and dwell times of 0.5 to 1 s in the turbulent wave and 2 to 2.2 s in the smooth wave. To prevent board warping during soldering, the clamping force on its longer sides exerted by the transport system must not exceed 0.5 N/cm.

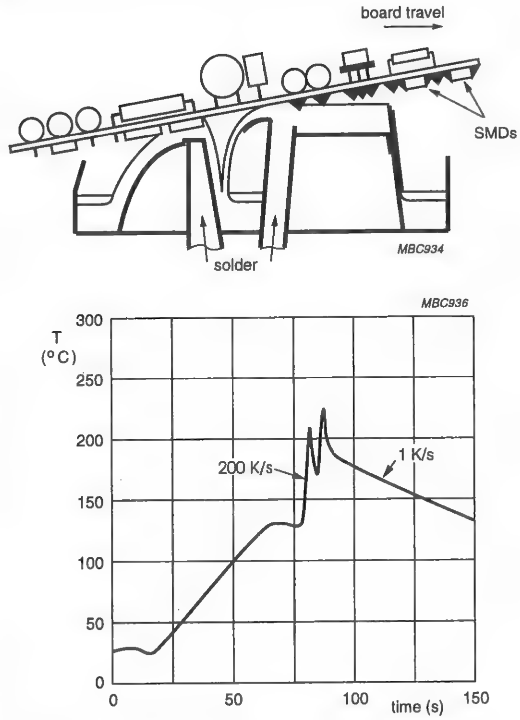


Fig.5.3 Double-wave soldering: (top) principle, (bottom) measured temperature profile of the leads at the immersion point

REFLOW SOLDERING

The reflow soldering environment

It's recommended that for solder pasting, the equipment is located in a controlled environment maintained at a temperature of 22 ± 2 °C, and a relative humidity of 55 +5/–10%.

Applying solder paste to the PCB

Reflow soldering uses a paste consisting of small nodules of solder and a flux with binder, solvents and additives to control rheological properties. Suitable types of Philips solder paste are SP029, SP032 or SP031 which have smaller solder particles, or SP026 with larger

particles (approx. 75 μm). The paste is then applied to the solder lands, and the ICs positioned on the PCB. On heating to a temperature above the melting point of the solder alloy, the mixture reflows to form soldered joints.

Solder paste is applied to the PCB by one of either three methods: screen printing, stencilling or dispensing syringe.

Screen printing

A fine-mesh screen coated with emulsion, except the areas where paste is required, is placed over the PCB (see Fig.5.4). A squeegee is then passed across the screen to force solder paste through the areas in the emulsion and onto the solder lands on the PCB. An 80-mesh screen is normally used, and 0.5 to 0.7 mg/mm^2 of solder paste should be applied to the solder lands of the PCB.

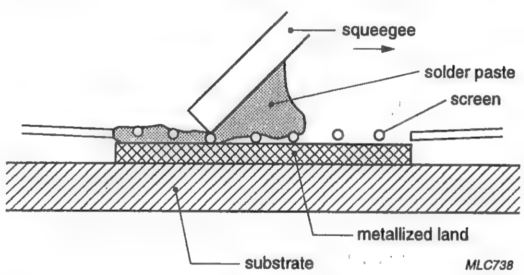


Fig.5.4 Applying solder paste by screen printing

Stencilling

This is similar to screen printing, except that a metal stencil is used instead of a fine-mesh screen.

The stencil is usually made of stainless steel or bronze and should be 200 μm thick with a step-etched pattern 125 μm thick formed by chemical etching. To ensure that the edges of the openings in the stencil are always positioned within the solder lands, the dimensions of the openings should be about 10% smaller than those of the lands.

Dispensing syringe

This method uses an air- or mechanically-driven syringe to deposit paste to each solder land (Fig.5.5). Although it is comparatively slow, it allows a precisely measured amount of paste to be deposited at each position.

Table 2 shows the amount of paste required per joint for various IC packages.

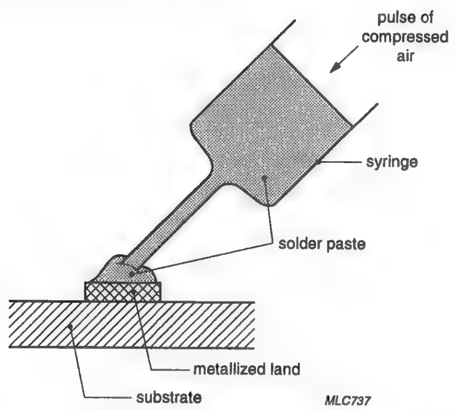


Fig.5.5 Dispensing solder paste by syringe

TABLE 2
Amount of dispensed paste per solder joint for various IC packages

package	solder paste/joint (mg)
SO (6.60 mm)	0.5-0.7
SO (11.00 mm)	0.75
SSOP	0.25
VSO	0.5
TSSOP	0.25
QFP	0.7 - 1.0
SQFP	0.25
LQFP	0.25
TQFP	0.25
PLCC	1.0

Positioning the IC on the PCB

Positioning ICs on the PCB is identical in practice as for wave soldering, except it is the tackiness (tack strength) of the solder paste and not an adhesive, that holds the IC in place before soldering. Tack strength depends on factors such as paste composition, drying conditions, placement pressure, dwell time and contact area.

A touchdown force of 30 N distributed over the total surface area of the IC is sufficient to ensure that all its leads contact the solder lands.

Reflow soldering methods

There are several methods available to provide the heat to reflow the solder paste. The main systems used at the present time are: infrared, hot belt, hot gas, vapour phase and resistance soldering.

Infrared/convection reflow

Infrared ovens usually have different types of heating element, operating in the mid- to far-IR regions, normally above and below a moving belt. There are three zones: for preheating, soldering and cooling, and total throughput time is about 100 to 200 s (see Fig.5.6).

The main limitation of IR reflow is that the components and materials used in the construction of the PCB absorb, transmit and reflect IR radiation at different rates. For example, IC leads are good IR reflectors, whereas the black IC packages make excellent IR absorbers. This results in an uneven temperature profile across the board. However, extending the exposure time can reduce this effect.

IR reflow soldering is mainly used to solder ICs on glass-epoxy boards. A variation on this is the combined infrared/convection system. Such a system results in a more uniform heat distribution between board and components, and peak temperature (T_p) of the components can be 20 °C lower (see Fig 5.6).

Hot belt soldering

With hot belt (or thermal conduction) soldering, the assembled PCBs are heated from below through a thin Teflon/fibreglass transfer belt, which is in contact with temperature-controlled hot plates. Boards lying on the moving belt pass over three or more hot plates for preheating, soldering and cooling. Overhead infrared lamps can also be used to supply additional heat during the soldering stage to ensure a more even distribution of heat.

Belt speed depends on the substrate used, but is typically 25 cm/min for a 1.6 mm glass-epoxy board, and 120 cm/min for a 0.6 mm ceramic substrate.

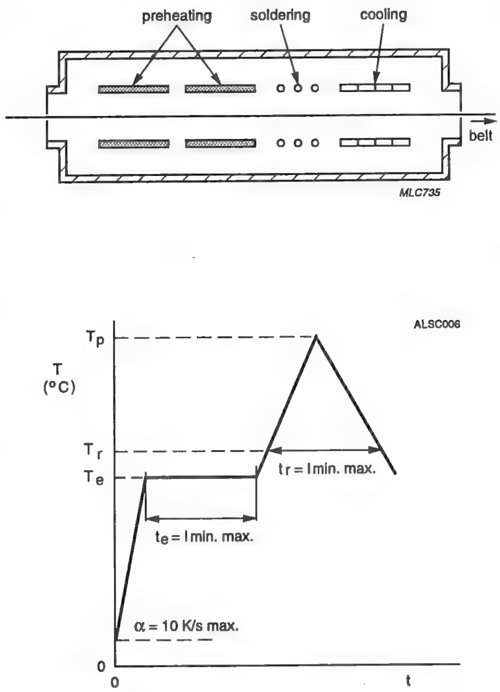


Fig.5.6 IR reflow soldering (top) method (bottom) time/temperature profile
t_e = 160 °C max., T_r = 180 °C, T_p = 215 to 280 °C

Hot gas soldering

With this method, a small gun with a nozzle diameter of about 2.5 mm, issues air, nitrogen or other suitable gas at a temperature of around 400 °C and a flow rate of 1.5 litres/min. The jet should be continually move along the package leads to avoid overheating the PCB. Ceramic substrates should be preheated to around 150 °C and the gas jet directed to each IC lead in turn.

Although this method is slow, it is useful in small production runs, in laboratory applications and for de-soldering ICs.

Vapour phase reflow

In vapour phase reflow, vapour from a suitable boiling liquid transfers latent heat of condensation to the substrate. Provided the liquid boils at a temperature higher than the melting point of the solder, the paste will reflow. Normally, a liquid fluorocarbon compound that boils around 215 °C is used. The boiling liquid provides precise temperature control, a fast heating rate, uniform heating over the whole substrate, and an inert atmosphere.

Vapour phase reflow uses an in-line or batch system. With an in-line system (Fig.5.7) the belt travels at around 1 m/min, has a throughput time of 200 s and a dwell time in the hot vapour of about 30 s.

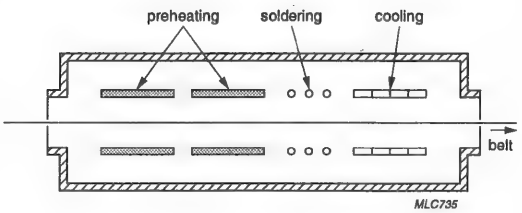


Fig.5.7 In-line system for vapour phase reflow

A batch system has a secondary blanket of lighter vapour such as trichlorotrifluoroethane (boiling point 40 °C) which floats on top of the primary vapour to confine it. A batch of assembled substrates is lowered into the fluorocarbon vapour for 20 to 40 s, and then cooled by raising it into the upper vapour for 30 to 50 s. Duration depends on the batch size. Flux residues that build up in the system are removed by filtering, either continually or at the end of each day. Acid, which is a decomposition product of the secondary fluid, is removed by passing the condensate through a scrubber.

Since leads heat more quickly than the substrate, solder tends to flow onto the lands and not onto the joint (the wick effect). So if the gap between lead and solder land is more than 100 µm the soldered joint may be incomplete, or it may not form at all. Because the temperature difference between leads and substrate is less in IR heating than it is in vapour-phase heating, the gap between leads and solder can be larger (150 µm).

Resistance soldering

Resistance soldering uses a heated element in contact with the joint to reflow the solder. However, solder paste should not be used with this method as the solder tends to spatter during rapid heating. Instead, an extra thick layer (15 to 30 µm) of tin/lead solder is plated directly on to the solder leads.

As each IC package type and size requires its own heating element, this method is slow and will probably be restricted to development work. Soldering ICs, such as SOs and PLCCs, is also very difficult as they have leads that are too short and stiff to bend and fit the tool. However, it is an excellent tool for de-soldering and soldering QFPs, VSOs and other IC with long, flexible gull-wing leads.

REPLACING A SOLDERED IC

De-soldering the IC

SMD ICs can be removed from a PCB by heating the IC leads with a heating element (see **Resistance soldering**) or by heating the leads on both sides of the package with a hot air gun with a small orifice nozzle (see **Hot gas soldering**). The IC can then be removed with a pair of tweezers. However, care must be taken not to damage the solder lands or any other components on the PCB.

Applying solder paste to the PCB

Before replacing the IC, a dispenser is used to place a small dot (see Table 2) of solder paste (such as Philips SP032, which is modified for dispenser applications) on each solder land.

Positioning the new IC

The new IC can now be placed manually on the PCB. See the relevant footprint diagram for the placement accuracy of the IC.

A touchdown force of 30 N distributed over the total surface area of the IC is sufficient to ensure that all its leads contact the solder lands.

Soldering the new IC

The solder paste can be reflowed by either a resistance element or by hot air (see **Resistance soldering** and **Hot gas soldering**)

ASSESSMENT OF SOLDERED JOINT QUALITY

The quality of a soldered joint is assessed by inspecting the shape and appearance of the joint. This inspection is normally done with either a low-powered magnifier or microscope, however where ultra-high reliability is required, video, X-ray or laser inspection equipment should be considered.

Both sides of the PCB should be carefully examined: there should be no misaligned, missing or damaged components, soldered joints should be clean and have a similar appearance, there should be no solder bridging or residue, the length of through-hole component terminations must be within prescribed limits, and the PCB should be assessed for general cleanliness.

Unlike leaded component joints where the lead also provides added mechanical strength, the SMD relies on the quality of the soldering for both electrical and mechanical integrity. It is therefore necessary that the inspector is trained to make a visual assessment with regard to long-term reliability.

Criteria used to assess the quality of an SMD solder joint include:

- correct positioning of the IC on the solder lands
- good wetting of the surfaces
- correct amount of solder
- a sound, smooth joint surface.

Positioning - if a lead projects over its solder land too far, an unreliable joint is obtained, which is obviously not acceptable. A projection of less than half the width of the lead can be acceptable depending on factors such as the electrical insulation distance that needs to be maintained (typically 0.2 mm for low-voltage applications).

Shifting in the longitudinal direction is not a problem, provided the whole foot of the lead and the meniscus (the curved surface of the solder caused by surface tension) in the heel is on the solder land.

Good wetting - this produces an even flow of solder over the surface land and component lead, and thinning towards the edges of the joint. The metallic interaction that takes place during soldering should give a smooth, unbroken, adherent layer of solder on the joint.

Correct amount of solder - a good soldered joint should have neither too much nor too little solder: there should be enough solder to ensure electrical and mechanical integrity, but not so much that it causes solder bridging.

Sound, smooth joint surface - the surface of the solder should be smooth, shiny and continuous. Small irregularities on the solder surface are acceptable, but cracks are unacceptable.

All packages (excluding PLCC)

An optimum joint should have the wedge-shape space between the underside of the lead and the solder land filled with solder, with a meniscus height equal to the thickness of the lead (Fig.5.8). The acceptable minimum is a meniscus height at least half the lead thickness. The sides of the lead should be wetted, and although it is not necessary for the cut end of the foot to be wetted, a meniscus is usually present.

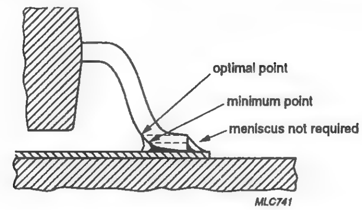


Fig.5.8 Joint criteria for all packages (excluding PLCC)

PLCC packages

In an ideal joint, the sides of the lead should be wetted and the area between the outside bend and solder land should be filled with solder to a height equal to the thickness of the lead (Fig.5.9). A meniscus extending to half the lead thickness is the acceptable minimum.

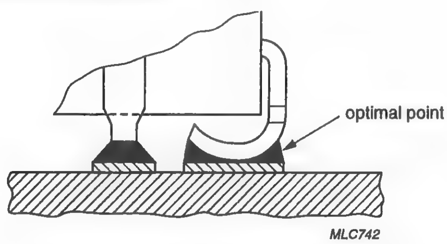


Fig.5.9 Joint criteria for PLCC packages

FOOTPRINTS FOR IC PACKAGES

A footprint pattern can be represented as a set of nominal coordinates and dimensions. The actual values are distributed around the nominal values owing to positional and processing tolerances, dimensional tolerances, and placement machine tolerances.

Calculation of these patterns, using simple worst-case parameters, is impractical. A better approach is to apply statistical analysis.

Figures 12 to 19 on the following pages show footprints for most of our IC packages. There are also details on some figures that are specific to wave soldering such as the indicated direction of the transport of the PCB and the location of solder thieves. The use of solder thieves (areas of metallization in addition to, or attached to, the downstream pair of solder lands of the IC footprint) is recommended for wave soldering as they reduce the likelihood of solder bridging on these lands.

Optimum solder penetration during wave soldering is obtained when SO, VSO, SSOP and TSSOP packages are mounted lengthwise (central axis parallel to the direction of travel over the wave, as shown in Fig.10). If board space is limited, mounting SO packages transversely (central axis at 90° to the direction of travel over the wave) is possible, see Fig.11. However, we do not recommend this mounting method, and it is unsuitable for VSO, SSOP and TSSOP packages. QFP, SQFP, LQFP and TQFP packages can only be soldered if placed at a 45° angle the solder wave direction.

ICs have no orientation preference for reflow soldering.

Although the ideal would be to locate an IC exactly in its correct position on the solder lands, in practice some tolerance is allowed. This tolerance is usually expressed as the *placement accuracy*, that is, the deviation of a component lead from its nominal position on the solder lands. The maximum placement deviations for each IC are given with the relevant footprint design.

All footprint dimensions are based on our experience with both development and production boards, and are reproduced for guidance only.

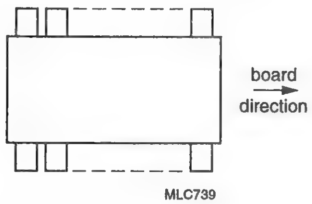


Fig.5.10 Parallel positioning for SO, SSOP, VSO and TSSOP packages

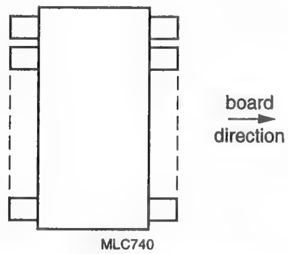


Fig.5.11 Transverse positioning for SO packages only

SO PACKAGES (REFLOW SOLDERING)

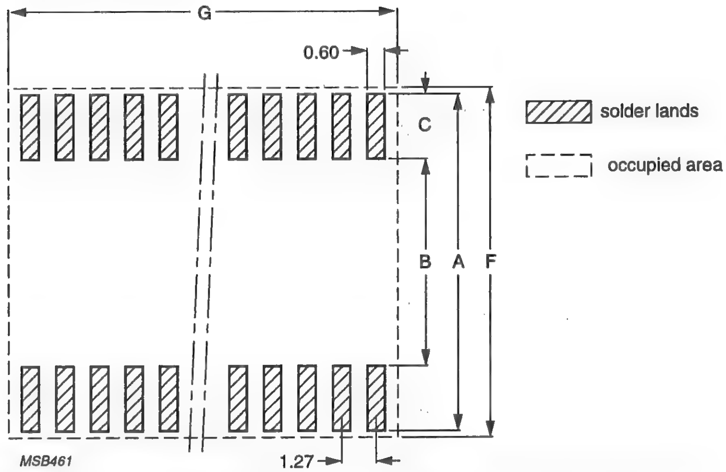


Fig.5.12 PCB footprint for mounting SO packages (reflow soldering)

REFLOW SOLDERING							
Package name	Philips outline code	Footprint dimensions in mm					Placement accuracy
		A	B	C	F	G	
SO8	SOT96-1	6.60	4.00	1.30	7.00	5.50	±0.25
SO8	SOT176-1	11.00	8.00	1.50	11.40	8.40	±0.25
SO14	SOT108-1	6.60	4.00	1.30	7.00	9.30	±0.25
SO16	SOT109-1	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT109-2	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT162-1	11.00	8.00	1.50	11.40	10.90	±0.25
SO20	SOT163-1	11.00	8.00	1.50	11.40	13.40	±0.25
SO24	SOT137-1	11.00	8.00	1.50	11.40	16.00	±0.25
SO28	SOT136-1	11.00	8.00	1.50	11.40	18.50	±0.25
SO28	SOT213-1	12.40	9.00	1.70	12.80	18.60	±0.25
SO32	SOT287-1	11.00	8.00	1.50	11.40	21.20	±0.25

SO PACKAGES (WAVE SOLDERING)

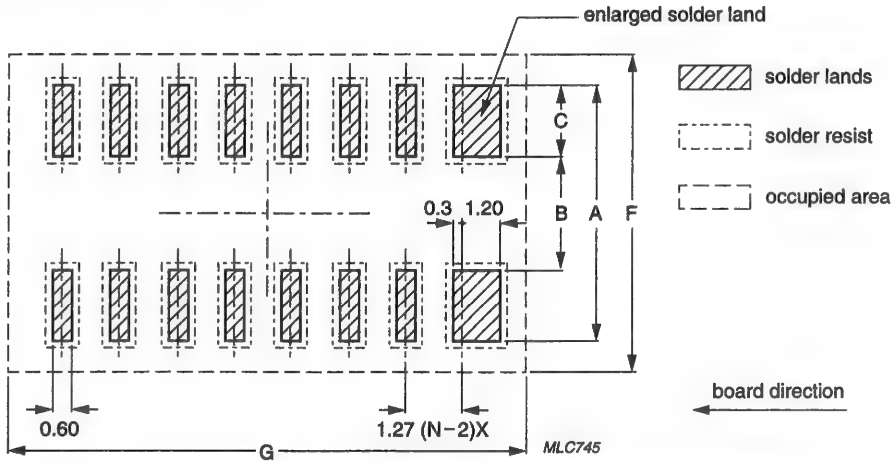


Fig.5.13 PCB footprint for mounting SO packages (wave soldering)

WAVE SOLDERING								
Package name	Philips outline code	N	Footprint dimensions in mm					Placement accuracy
			A	B	C	F	G	
SO8	SOT96-1	8	8.00	3.80	2.10	9.40	7.10	±0.25
SO8	SOT176-1	8	11.50	7.90	1.80	13.00	10.90	±0.25
SO14	SOT108-1	14	8.00	3.80	2.10	9.40	10.80	±0.25
SO16	SOT109-1	16	8.00	3.80	2.10	9.40	12.10	±0.25
SO16	SOT109-2	16	8.00	3.80	2.10	9.40	12.10	±0.25
SO16	SOT162-1	16	11.50	7.90	1.80	13.00	13.40	±0.25
SO20	SOT163-1	20	11.50	7.90	1.80	13.00	15.90	±0.25
SO24	SOT137-1	24	11.50	7.90	1.80	13.00	18.50	±0.25
SO28	SOT136-1	28	11.50	7.90	1.80	13.00	21.00	±0.25
SO28	SOT213-1	28	12.70	9.00	1.85	14.20	21.50	±0.25
SO32	SOT287-1	32	11.60	7.60	2.00	13.10	23.70	±0.25

SSOP, VSO & TSSOP PACKAGES (REFLOW SOLDERING)

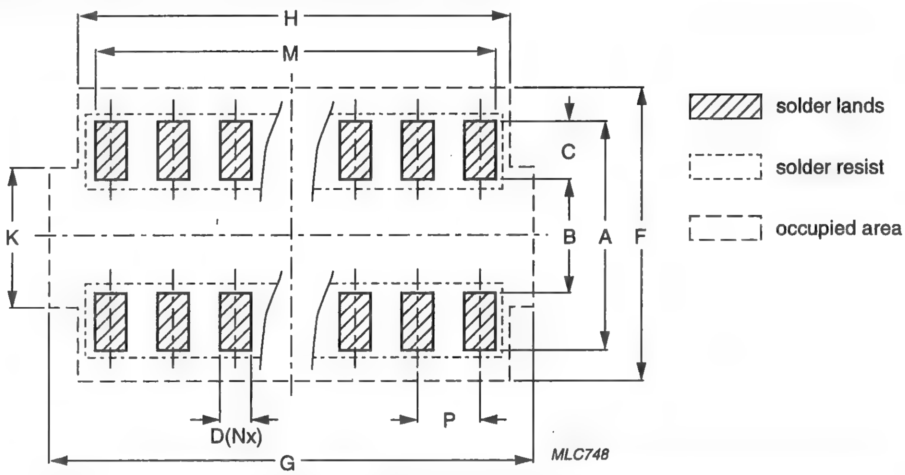


Fig.5.14 PCB footprint for mounting SSOP, VSO & TSSOP packages (reflow soldering)

REFLOW SOLDERING

Package name	Philips outline code	N	Footprint dimensions in mm										Placement accuracy
			P	A	B	C	D	F	G	H	K	M	
SSOP14	SOT337-1	14	0.65	8.10	5.70	1.20	0.40	8.35	6.50	4.55	5.55	4.30	±0.15
SSOP16	SOT338-1	16	0.65	8.10	5.70	1.20	0.40	8.35	6.50	5.20	5.55	4.95	±0.15
SSOP16	SOT369-1	16	0.65	6.80	4.80	1.00	0.40	7.05	5.55	5.55	7.05	4.95	±0.15
SSOP20	SOT266-1	20	0.65	6.80	4.80	1.00	0.40	7.05	6.85	6.85	7.05	6.25	±0.15
SSOP20	SOT339-1	20	0.65	8.10	5.90	1.10	0.40	8.35	7.50	6.50	5.55	6.25	±0.15
SSOP24	SOT340-1	24	0.65	8.10	5.90	1.10	0.40	8.35	8.50	7.80	5.55	7.55	±0.15
SSOP28	SOT341-1	28	0.65	8.10	5.90	1.10	0.40	8.35	10.50	9.10	5.60	8.85	±0.15
SSOP36	SOT378-1	36	0.80	10.80	7.80	1.50	0.40	11.05	15.70	14.40	7.80	14.00	±0.15
SSOP48	SOT370-1	48	0.635	10.60	8.20	1.20	0.40	10.85	16.15	15.255	7.80	15.005	±0.15
SSOP56	SOT371-1	56	0.635	10.60	8.20	1.20	0.40	10.85	18.70	17.795	7.80	17.545	±0.15
VSO40	SOT158-1	40	0.762	12.60	8.20	2.20	0.40	13.00	16.20	–	–	–	±0.10
VSO40	SOT158-2	40	0.762	12.60	8.20	2.20	0.40	13.00	16.20	–	–	–	±0.10
VSO56	SOT190-1	56	0.75	16.10	11.90	2.10	0.40	16.50	22.20	–	–	–	±0.10
TSSOP14	SOT402-1	14	0.65	6.80	4.60	1.10	0.40	7.05	5.25	4.55	4.65	4.30	±0.15
TSSOP16	SOT403-1	16	0.65	6.80	4.60	1.10	0.40	7.05	5.25	5.25	7.05	4.95	±0.15
TSSOP20	SOT360-1	20	0.65	6.80	4.60	1.10	0.40	7.05	6.75	6.75	7.05	6.25	±0.15
TSSOP24	SOT355-1	24	0.65	6.80	4.60	1.10	0.40	7.05	8.05	8.05	7.05	7.55	±0.15
TSSOP28	SOT361-1	28	0.65	6.80	4.60	1.10	0.40	7.05	9.95	9.10	4.70	8.85	±0.15
TSSOP48	SOT362-1	48	0.50	8.50	6.50	1.00	0.285	9.75	13.035	13.035	9.75	11.785	±0.10
TSSOP56	SOT364-1	56	0.50	8.50	6.50	1.00	0.285	9.75	15.035	15.035	9.75	13.785	±0.10

SSOP, VSO & TSSOP PACKAGES (WAVE SOLDERING)

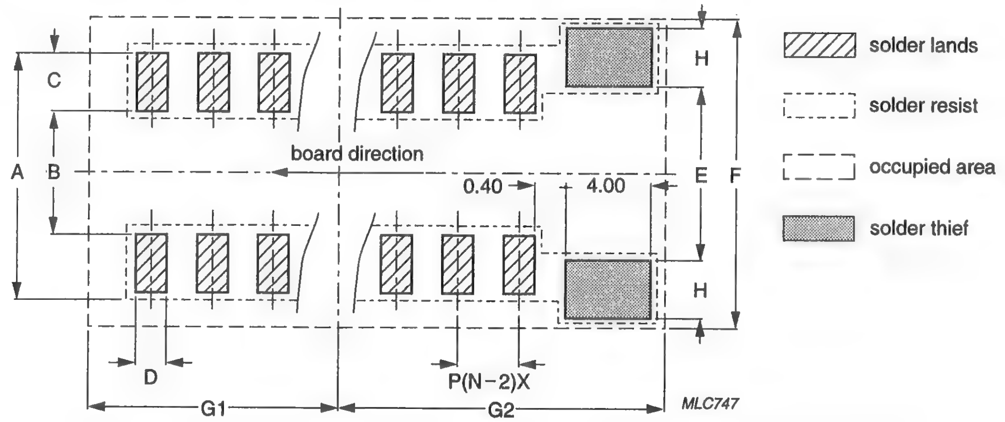


Fig.5.15 PCB footprint for mounting SSOP, VSO & TSSOP packages (wave soldering)

WAVE SOLDERING													
Package name	Philips outline code	N	Footprint dimensions in mm										Placement accuracy
			P	A	B	C	D	E	F	G1	G2	H	
SSOP14	SOT337-1	14	0.65	9.15	5.35	1.90	0.30	6.15	10.65	4.25	6.75	2.00	±0.10
SSOP16	SOT338-1	16	0.65	9.15	5.35	1.90	0.30	6.15	10.65	4.25	7.075	2.00	±0.10
SSOP16	SOT369-1	16	0.65	8.30	4.50	1.90	0.30	5.30	9.80	3.55	7.075	2.00	±0.15
SSOP20	SOT266-1	20	0.65	8.30	4.50	1.90	0.30	5.30	9.80	4.20	7.725	2.00	±0.15
SSOP20	SOT339-1	20	0.65	9.15	5.55	1.80	0.30	6.30	10.80	4.75	7.725	2.00	±0.10
SSOP24	SOT340-1	24	0.65	9.15	5.55	1.80	0.30	6.30	10.80	5.25	8.375	2.00	±0.10
SSOP28	SOT341-1	28	0.65	9.15	5.55	1.80	0.30	6.30	10.80	6.25	9.025	2.00	±0.10
SSOP36	SOT378-1	36	0.80	11.40	7.60	1.90	0.40	8.50	13.30	9.20	11.65	2.15	±0.15
SSOP48	SOT370-1	Not suitable for wave soldering											
SSOP56	SOT371-1	Not suitable for wave soldering											
VSO40	SOT158-1	40	0.762	12.80	8.20	2.30	0.35	9.20	14.30	9.50	12.10	2.30	±0.10
VSO40	SOT158-2	40	0.762	12.80	8.20	2.30	0.35	9.20	14.30	9.50	12.10	2.30	±0.10
VSO56	SOT190-1	56	0.75	16.20	11.80	2.20	0.35	12.80	17.70	12.70	15.00	2.20	±0.10
TSSOP14	SOT402-1	14	0.65	8.30	4.50	1.90	0.30	5.15	9.80	3.20	6.75	2.075	±0.15
TSSOP16	SOT403-1	16	0.65	8.30	4.50	1.90	0.30	5.15	9.80	3.20	7.075	2.075	±0.15
TSSOP20	SOT360-1	20	0.65	8.30	4.50	1.90	0.30	5.15	9.80	3.95	7.725	2.075	±0.15
TSSOP24	SOT355-1	24	0.65	8.30	4.50	1.90	0.30	5.15	9.80	4.60	8.375	2.075	±0.15
TSSOP28	SOT361-1	28	0.65	8.30	4.50	1.90	0.30	5.15	9.80	5.55	9.025	2.075	±0.15
TSSOP48	SOT362-1	Not suitable for wave soldering											
TSSOP56	SOT364-1	Not suitable for wave soldering											

QFP, SQFP, LQFP & TQFP PACKAGES (REFLOW SOLDERING)

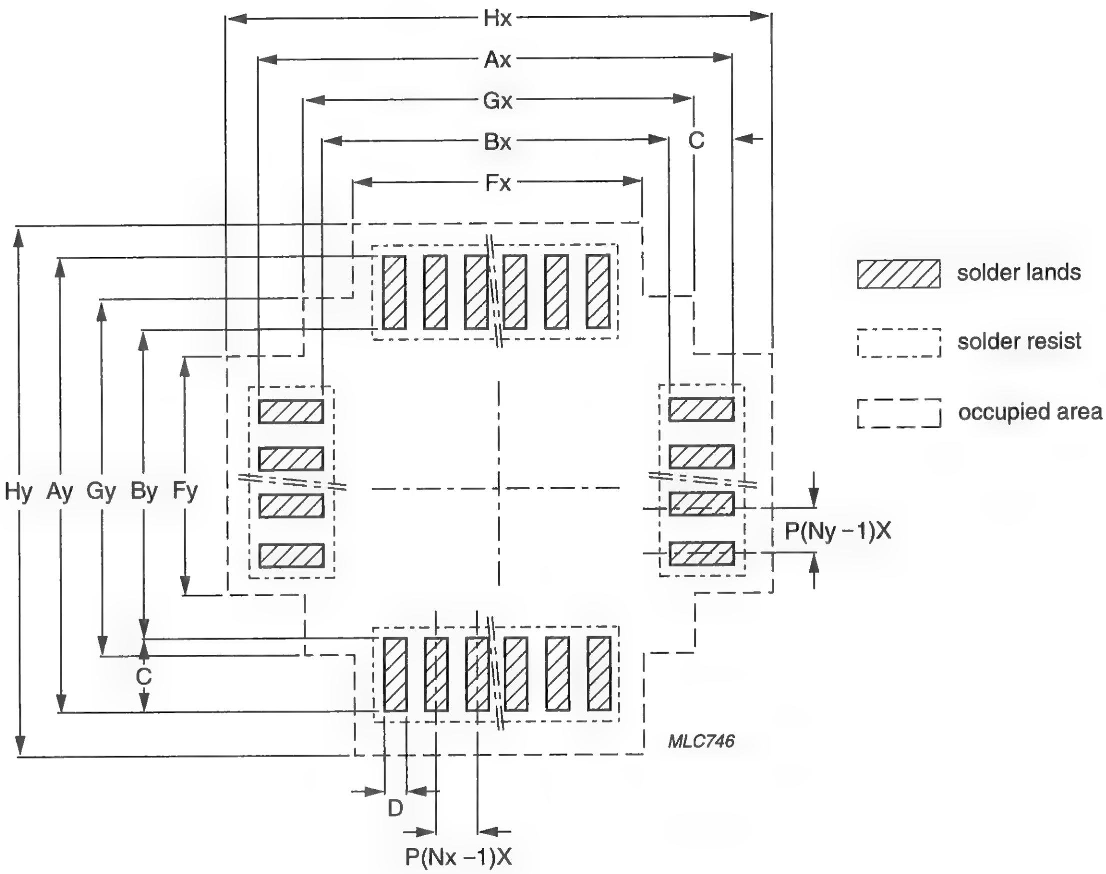


Fig.5.16 PCB footprint for mounting QFP, SQFP, LQFP & TQFP packages (reflow soldering)

REFLOW SOLDERING

Package name	Philips outline code	Nx	Ny	Footprint dimensions in mm													Placement accuracy
				P	Ax	Ay	Bx	By	C	D	Fx	Fy	Gx	Gy	Hx	Hy	
QFP44	SOT205-1	11	11	1.00	19.40	19.40	14.80	14.80	2.30	0.60	11.00	11.00	14.40	14.40	19.65	19.65	±0.25
QFP44	SOT307-2	11	11	0.80	13.50	13.50	10.50	10.50	1.50	0.40	8.75	8.75	10.25	10.25	13.35	13.35	±0.15
QFP52	SOT379-1	13	13	0.65	13.65	13.65	10.85	10.85	1.40	0.40	8.45	8.45	10.25	10.25	13.90	13.90	±0.15
QFP64	SOT319-1	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	19.00	13.00	20.40	14.40	24.65	18.65	±0.25
QFP64	SOT319-2	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	19.00	13.00	20.40	14.40	24.65	18.65	±0.25
QFP64	SOT319-3	19	13	1.00	25.20	19.20	21.60	15.60	1.80	0.60	19.00	13.00	20.40	14.40	25.45	19.45	±0.25
QFP64	SOT393-1	16	16	0.80	17.65	17.65	14.85	14.85	1.40	0.40	12.80	12.80	14.25	14.25	17.90	17.90	±0.15
QFP80	SOT310-1	24	16	0.80	23.80	17.80	21.00	15.00	1.40	0.40	19.20	12.80	20.25	14.25	24.05	18.05	±0.15
QFP80	SOT318-1	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65	±0.15
QFP80	SOT318-2	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65	±0.15
QFP80	SOT318-3	24	16	0.80	25.20	19.20	21.60	15.60	1.80	0.40	19.20	12.80	20.25	14.25	25.45	19.45	±0.15
QFP100	SOT317-1	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP100	SOT317-2	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP100	SOT382-1	30	20	0.65	23.65	17.65	20.85	14.85	1.40	0.40	19.50	13.00	20.25	14.25	23.90	17.90	±0.15
QFP120	SOT349-1	30	30	0.80	32.40	32.40	29.40	29.40	1.50	0.40	24.00	24.00	28.25	28.25	32.65	32.65	±0.15
QFP120	SOT383-1	30	30	0.80	31.65	31.65	28.85	28.85	1.40	0.40	24.00	24.00	28.25	28.25	31.90	31.90	±0.15
QFP128	SOT320-1	32	32	0.80	32.40	32.40	29.40	29.40	1.50	0.40	25.60	25.60	28.25	28.25	32.65	32.65	±0.15
QFP160	SOT322-1	40	40	0.65	32.40	32.40	29.40	29.40	1.50	0.40	26.00	26.00	28.25	28.25	32.65	32.65	±0.15
SQFP128	SOT387-1	36	28	0.50	23.70	17.70	20.90	14.90	1.40	0.285	20.20	14.20	20.20	14.20	24.95	18.95	±0.10
SQFP208	SOT316-1	52	52	0.50	31.10	31.10	28.70	28.70	1.20	0.285	27.03	27.03	28.20	28.20	32.35	32.35	±0.10
LQFP32	SOT358-1	8	8	0.80	9.50	9.50	7.30	7.30	1.10	0.40	6.40	6.40	7.25	7.25	9.75	9.75	±0.15
LQFP44	SOT389-1	11	11	0.80	12.35	12.35	10.35	10.35	1.00	0.40	8.80	8.80	10.25	10.25	12.60	12.60	±0.15
LQFP48	SOT313-1	12	12	0.50	9.50	9.50	7.30	7.30	1.10	0.285	7.20	7.20	7.20	7.20	10.75	10.75	±0.10
LQFP48	SOT313-2	12	12	0.50	9.50	9.50	7.30	7.30	1.10	0.285	7.20	7.20	7.20	7.20	10.75	10.75	±0.10
LQFP64	SOT314-2	16	16	0.50	12.50	12.50	10.30	10.30	1.10	0.285	9.035	9.035	10.20	10.20	13.75	13.75	±0.10
LQFP80	SOT315-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	11.035	11.035	12.20	12.20	15.75	15.75	±0.10
TQFP44	SOT376-1	11	11	0.80	12.40	12.40	10.40	10.40	1.00	0.40	8.70	8.70	10.30	10.30	12.65	12.65	±0.15
TQFP64	SOT357-1	16	16	0.50	12.40	12.40	10.40	10.40	1.00	0.285	9.035	9.035	10.25	10.25	13.65	13.65	±0.10
TQFP80	SOT375-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	11.035	11.035	12.20	12.20	15.75	15.75	±0.10
TQFP100	SOT386-1	25	25	0.50	16.50	16.50	14.30	14.30	1.10	0.285	13.535	13.535	14.20	14.20	17.75	17.75	±0.10

QFP, SQFP, LQFP & TQFP PACKAGES (WAVE SOLDERING)

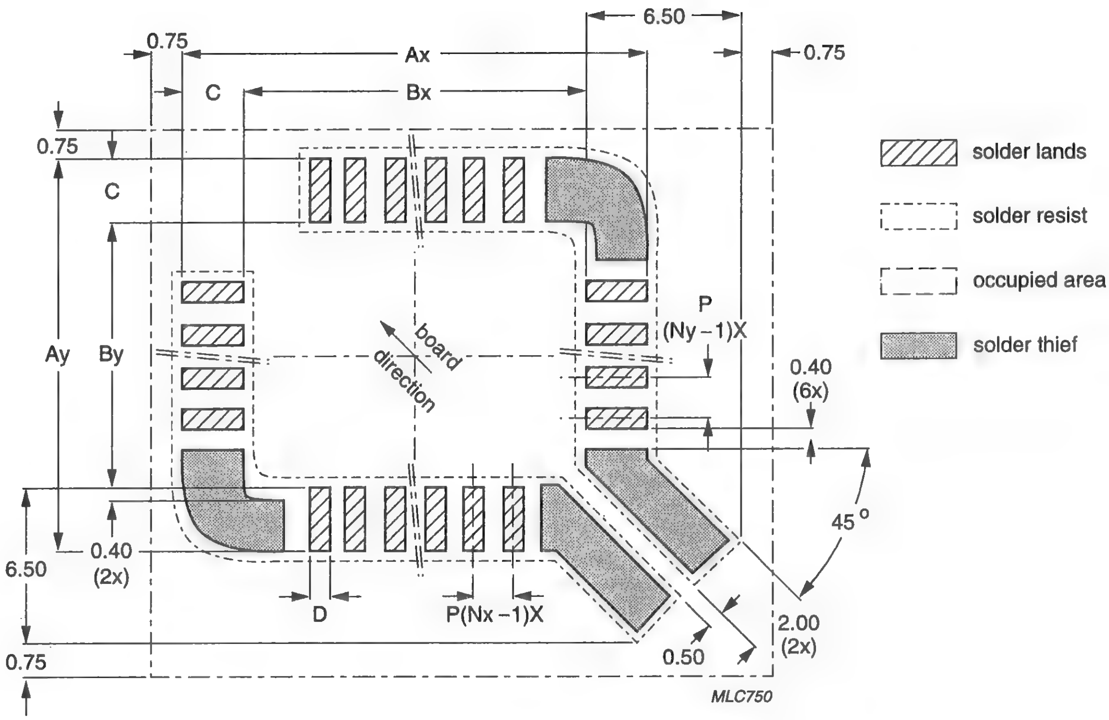


Fig.5.17 PCB footprint for mounting QFP, SQFP, LQFP & TQFP packages (wave soldering)

WAVE SOLDERING

Package name	Philips outline code	Nx	Ny	Footprint dimensions in mm							Placement accuracy
				P	Ax	Ay	Bx	By	C	D	
QFP44	SOT205-1	11	11	1.00	19.80	19.80	14.40	14.40	2.70	0.50	±0.25
QFP44	SOT307-2	11	11	0.80	13.90	13.90	10.30	10.30	1.80	0.40	±0.15
QFP52	SOT379-1	Not suitable for wave soldering									
QFP64	SOT319-1	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	±0.25
QFP64	SOT319-2	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	±0.25
QFP64	SOT319-3	13	19	1.00	19.70	25.70	15.30	21.30	2.20	0.50	±0.25
QFP64	SOT393-1	16	16	0.80	17.95	17.95	14.75	14.75	1.60	0.40	±0.15
QFP80	SOT310-1	16	24	0.80	18.10	24.10	14.70	20.70	1.70	0.40	±0.15
QFP80	SOT318-1	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	±0.15
QFP80	SOT318-2	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	±0.15
QFP80	SOT318-3	16	24	0.80	19.50	25.50	15.50	21.50	2.00	0.40	±0.15
QFP100	SOT317-1	Not suitable for wave soldering									
QFP100	SOT317-2	Not suitable for wave soldering									
QFP100	SOT382-1	Not suitable for wave soldering									
QFP120	SOT349-1	30	30	0.80	32.70	32.70	29.30	29.30	1.70	0.40	±0.15
QFP120	SOT383-1	30	30	0.80	31.95	31.95	28.95	28.95	1.50	0.40	±0.15
QFP128	SOT320-1	32	32	0.80	32.70	32.70	29.30	29.30	1.70	0.40	±0.15
QFP160	SOT322-1	Not suitable for wave soldering									
SQFP128	SOT387-1	Not suitable for wave soldering									
SQFP208	SOT316-1	Not suitable for wave soldering									
LQFP32	SOT358-1	8	8	0.80	10.95	10.95	7.15	7.15	1.90	0.40	±0.15
LQFP44	SOT389-1	11	11	0.80	13.90	13.90	10.10	10.10	1.90	0.40	±0.15
LQFP48	SOT313-1	Not suitable for wave soldering									
LQFP48	SOT313-2	Not suitable for wave soldering									
LQFP64	SOT314-2	Not suitable for wave soldering									
LQFP80	SOT315-1	Not suitable for wave soldering									
TQFP44	SOT376-1	11	11	0.80	13.95	13.95	10.15	10.15	1.90	0.40	±0.15
TQFP64	SOT357-1	Not suitable for wave soldering									
TQFP80	SOT375-1	Not suitable for wave soldering									
TQFP100	SOT386-1	Not suitable for wave soldering									

PLCC PACKAGES (REFLOW SOLDERING)

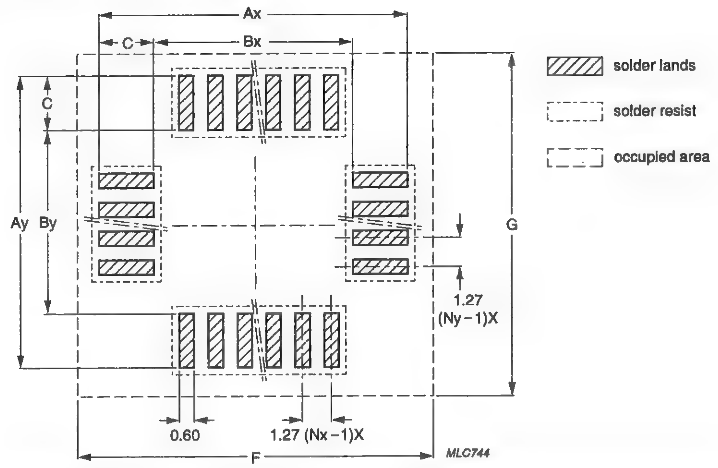


Fig.5.18 PCB footprint for mounting PLCC packages (reflow soldering)

REFLOW SOLDERING											
Package name	Philips outline code	Nx	Ny	Footprint dimensions in mm							Placement accuracy
				Ax	Ay	Bx	By	C	F	G	
PLCC20	SOT380-1	5	5	10.30	10.30	6.60	6.60	1.85	10.70	10.70	±0.25
PLCC28	SOT261-2	7	7	12.80	12.80	9.10	9.10	1.85	13.20	13.20	±0.25
PLCC28	SOT261-3	7	7	12.80	12.80	9.10	9.10	1.85	13.20	13.20	±0.25
PLCC32	SOT381-1	9	7	15.40	12.80	11.70	9.10	1.85	15.80	13.20	±0.25
PLCC44	SOT187-2	11	11	17.90	17.90	14.20	14.20	1.85	18.30	18.30	±0.25
PLCC52	SOT238-2	13	13	20.40	20.40	16.70	16.70	1.85	20.80	20.80	±0.25
PLCC52	SOT238-3	13	13	20.40	20.40	16.70	16.70	1.85	20.80	20.80	±0.25
PLCC68	SOT188-2	17	17	25.50	25.50	21.80	21.80	1.85	25.90	25.90	±0.25
PLCC68	SOT188-3	17	17	25.50	25.50	21.80	21.80	1.85	25.90	25.90	±0.25
PLCC84	SOT189-2	21	21	30.60	30.60	26.90	26.90	1.85	31.00	31.00	±0.25
PLCC84	SOT189-3	21	21	30.60	30.60	26.90	26.90	1.85	31.00	31.00	±0.25

PLCC PACKAGES (WAVE SOLDERING)

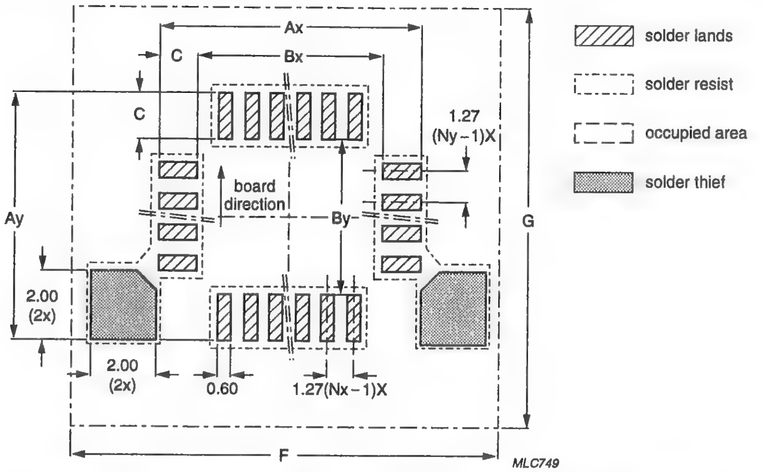


Fig.5.19 PCB footprint for mounting PLCC packages (wave soldering)

WAVE SOLDERING											
Package name	Philips outline code	Nx	Ny	Footprint dimensions in mm							Placement accuracy
				Ax	Ay	Bx	By	C	F	G	
PLCC20	SOT380-1	5	5	9.70	9.70	6.60	6.60	1.55	15.35	15.35	±0.25
PLCC28	SOT261-2	7	7	12.20	12.20	9.10	9.10	1.55	17.85	17.85	±0.25
PLCC28	SOT261-3	7	7	12.20	12.20	9.10	9.10	1.55	17.85	17.85	±0.25
PLCC32	SOT381-1	9	7	14.80	12.20	11.70	9.10	1.55	19.40	17.85	±0.25
PLCC44	SOT187-2	11	11	17.30	17.30	14.20	14.20	1.55	22.95	22.95	±0.25
PLCC52	SOT238-2	13	13	19.80	19.80	16.70	16.70	1.55	25.50	25.50	±0.25
PLCC52	SOT238-3	13	13	19.80	19.80	16.70	16.70	1.55	25.50	25.50	±0.25
PLCC68	SOT188-2	17	17	24.30	24.30	21.80	21.80	1.55	30.55	30.55	±0.25
PLCC68	SOT188-3	17	17	24.30	24.30	21.80	21.80	1.55	30.55	30.55	±0.25
PLCC84	SOT189-2	21	21	30.00	30.00	26.90	26.90	1.55	35.65	35.65	±0.25
PLCC84	SOT189-3	21	21	30.00	30.00	26.90	26.90	1.55	35.65	35.65	±0.25

SMD Assembly Equipment

Philips has been at the forefront of surface-mount technology since the pioneering days of the mid-1980s. Not only did we introduce the first small outline IC package, for example, we also led the way in automated circuit assembly by producing world's first high-volume SMD placement machines.

UNIQUE INSIGHT

To promote and built upon this expertise, Philips established the Electronics Manufacturing Technology (EMT) group to design and construct placement machines and their associated equipment. Over the subsequent years, Philips EMT has accumulated a wealth of experience and practical know-how in electronic manufacturing, based on an in-depth understanding of the equipment, processes and problems involved.

Today, although the range of placement machines remains the core element in Philips EMT's business, increasingly they are delivering not only the equipment but a total process solution. This can take the form of a complete production flow-line including, for example, placement machines, glue applicators, solder paste printers, ovens for curing or reflow soldering, testing equipment, board transport links and all the control software needed to implement PCB assembly in a client's own factory. This is further complemented by EMT's wide range of advisory and support services, such as program optimization, circuit layout recommendations and personnel training.

To remain at the leading edge in surface mount technology, Philips EMT's machines are continually updated and enhanced, ensuring that all customers have the best equipment and services possible to match their process requirements. Placement machines available at present extend from flexible modules for short-run, frequently changing batch output, to the world's fastest and most cost-efficient system for high-volume mass production.

The table below gives a brief overview of the SMD placement machines currently available, and is followed by a short description about each unit.

	CSM66	CSM84	CSM84V/VZ	CMS Comet		CMS Eclipse	FCM
				M version	L version		
Board size (lxwxt) – maximum (mm) – minimum (mm)	 330×250×3.5 50×30×0.2	 457×407×3.5 50×30×0.2	 457×407×3.5 50×30×0.2	 330×407×3 50×50×0.6	 457×407×3 50×50×0.6	 457×407×3 50×50×0.6	 460×406×3.0 50×50×0.6
Components/hour (max.)	6,500	6,500	4,500	15,000	15,000	5,000	60,000
Max. unique component inputs	120	120	120	255	255	255	176
8 mm feeder spaces	66	84	84	112	96	80	96
Feeder types – tape – stick – bulk – tray – LCS	 ✔ ✔ ✔ ✔ x	 ✔ ✔ ✔ ✔ ✔	 ✔ ✔ ✔ ✔ ✔	 ✔ ✔ ✔ 1) ✔	 ✔ ✔ ✔ 1) ✔	 ✔ ✔ ✔ 1) ✔	 ✔ x x x
Fiducial alignment	✔	✔	✔	✔	✔	✔	option
Vision alignment	x	option	✔	✔	✔	✔	laser align
Largest component 2)	QFP120 3)	QFP120 3)	QFP256	QFP208	QFP208	QFP336	SO16 4)

Notes:

1) with Tray Sequencer Option
2) smallest component placement for all types is 0402
3) when fitted with (optional) Remote Alignment System
4) larger sizes under development at publication date

COMPACT SURFACE MOUNTERS CSM 66, 84 & 84V/VZ

The Compact Surface Mounter (CSM) line offers outstanding flexibility, economy and reliability for low- to medium-volume SMD circuit assembly. Even the basic CSM 66 and 84 models include board mark sensing and fiducial alignment as standard features, ensuring high productivity and accuracies comparable to many far more costly systems. The CSM 84VZ and 84V machines add an accuracy-enhancing vision alignment system to the CSM 84. Used in combination with a fiducial CCD camera, these systems can detect components with bent, irregular or missing leads. For applications involving packages with delicate, fine-pitch leads a servo-controlled z (vertical) translation of the placement head can also be specified – ensuring consistent "soft-landings" for the components.

CSM COMET

The CSM Comet enables high-performance component handling at speeds normally associated with turret-type chipshooters. A top-of-the-range addition to Philips' Compact Surface Mounter Line, the CSM Comet employs two 16-nozzle placement head beams that can deliver more than 15,000 SMDs per hour, with full in-flight visual alignment of all components. The CSM Comet can assemble two boards simultaneously while at the same time components are being picked and vision checked. The vision system ensures optimum precision for devices from 0402 chips up to QFPs, with minimum lead pitches down to 0.5 mm. The mounting accuracy is ± 0.08 mm for QFPs. It also detects missing, bent or irregularly spaced leads, and faulty components are rejected. The CSM Comet is available in two versions: the standard model accepts PCBs measuring 330 × 407 mm (13 × 16 in), while the wide-board type accommodates up to 457 × 407 mm (18 × 16 in).

CSM ECLIPSE

The CSM Eclipse is a high-performance machine capable of placing 0402 chips up to fine-pitch QFPs, all in a machine taking up a floor space of just 1.65 × 1.30 m. Two Z-programmable heads allow a placement rate of up to 5000 SMDs per hour. The CSM Eclipse is equipped with a state-of-the-art laser alignment system mounted on the placement heads that performs in-flight alignment of components with a rectangular body, such as PLCCs and SO packages. In addition, an upward looking camera checks lead alignment on components such as QFPs. Placement accuracy is ± 0.10 mm for components aligned with the laser and ± 0.04 mm with camera alignment.

FAST COMPONENT MOUNTER FCM

Placing 60,000 or more SMDs per hour, the FCM Fast Component Mounter dramatically outpaces even the most rapid turret-type machines. Such outstanding productivity is achieved through an innovative design approach that permits extremely efficient board coverage. In addition, it offers the advantage of laser alignment for contactless handling of SMDs up to SO16.

For more information about Philips Electronic Manufacturing Technology and how they can help with your production processes, contact:

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CHAPTER 7
Thermal Design Considerations

The ability to describe the thermal performance characteristics of a semiconductor IC package is becoming increasingly crucial. Today, the quest for speed and performance in information processing/ transmission systems is taxing the ability of individual electronic components to maintain reliably low operating temperatures. The situation is further exacerbated by the demand for ever decreasing sizes of electronic devices because, in general, decreasing the size of an electronic package decreases the thermal performance. The designer must carefully balance the benefits of miniaturization and performance versus potential reduction in reliability of electronic components resulting from high operating temperatures.

THERMAL RESISTANCE

The ability of a particular semiconductor package to dissipate heat to its environment is expressed in terms of thermal resistance. This is conventionally expressed as Theta JA (θ_{JA}). This single entity describes the heat path impedance from the active surface of the semiconductor device (junction) to the ambient operating environment. θ_{JA} can be expressed by its constituents as follows:

$$\theta_{JA} = \theta_{JC} + \theta_{CA}$$

θ_{JC} is the impedance from junction to case (outside surface of package) and θ_{CA} is the impedance from case to ambient. It is sometimes useful to use only the θ_{JC} to describe high performance packages where case temperatures are important in the use of externally attached heat radiators. In these cases the overall θ_{JA} will be a new number, which includes the contribution of the heat radiator.

JUNCTION TEMPERATURE

With the θ_{JA} of a package known, the rise in junction temperature (T_J) with respect to the ambient temperature (T_A) can be determined with a given power (P_D) to the semiconductor device:

$$T_J = (\theta_{JA} \times P_D) + T_A$$

Where:
- T_J = junction temperature (°C)
- θ_{JA} = thermal resistance junction to ambient (°C/W)
- P_D = power dissipated (W)
- T_A = ambient temperature (°C)

It's important to note that a lower θ_{JA} indicates a higher thermal performance.

PACKAGE VARIABLES AFFECTING θ_{JA}

There are several factors which affect the characteristic thermal resistance of IC packages. Some of the more significant of these include the lead frame material, the design of the lead frame and the moulding compound.

Lead Frame Material

The lead frame material is one of the more important factors in IC package thermal resistance.

In early dual in-line packages (DIPs), a Ni/Fe alloy (A42) was the material of choice for lead frames as it provided a good combination of strength and formability as well as assembly process compatibility. However, with the continued miniaturization of IC packages and the need for increased electrical conductivity for advanced ICs, a switch to sophisticated copper alloys was required. Such copper alloy lead frames offer several advantages over A42:

- they have a high thermal conductivity which reduces thermal resistance, essential for packages such as the Shrink Small Outline Package (SSOP) and Thin Shrink Small Outline Package (TSSOP)
- their improved electrical conductivity enhances the electrical performance of a package

Most plastic encapsulated packages produced by Philip Semiconductors today incorporate copper alloy lead frames into their design.

Lead Frame Design

The design of a lead frame is another significant contributing factor to thermal resistance. The most important design aspect is the IC attach-pad size and tie bar design. However, the lead frame designer is often faced with fixed parameters such as die size and wire bonding limitations, which reduce lead frame design flexibility.

Moulding Compound

Moulding compounds also determine IC package thermal resistance. The mould compounds used by Philip Semiconductors are optimized for high purity and quality to provide good thermal performance and reliability.

Heat Spreaders

The option of a heat spreader, or heat slug, within some packages can improve thermal behaviour by spreading the heat over a larger area of the package, and so improve J_A or J_C

Adhesive and Plating Type

Other package related factors include die attach adhesive and lead frame plating type, but the actual influence on thermal resistance is small owing to the fine geometry of these factors.

THERMAL RESISTANCE TEST METHODS

Philip Semiconductors uses what is commonly called the Temperature Sensitive Parameter (TSP) method which meets MIL-STD 883C, Method 1012.1 (Fig.7.1).

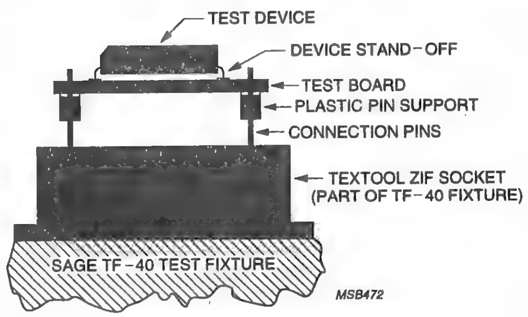


Fig.7.1 The TSP test method

The forward voltage drop of a calibrated diode incorporated into a special IC is used to correlate a junction temperature change in the IC package to be tested. As the power dissipation is known, the thermal resistance can be calculated using the following equation:

$$\theta_{JA} = \frac{\Delta T_J}{P_D} = \frac{(T_J - T_A)}{P_D}$$

Where: θ_{JA} = thermal resistance junction to ambient (°C/W)
T_J = junction temperature (°C)
P_D = power dissipated (W)
T_A = ambient temperature (°C)

TEST PROCEDURE

The TSP diode on the semiconductor device is calibrated using a constant temperature oil bath and a constant current power supply (see Fig.7.2).

The calibration temperatures are typically 25 °C and 75 °C with a measured accuracy of ± 0.1 °C. The calibration current must be kept low and constant to avoid significant junction heating. The temperature coefficient (K-factor) shown in Fig.7.3 is calculated using the following equation:

$$K = \frac{(T_2 - T_1)}{(V_{F2} - V_{F1})}$$

Where: K = temperature coefficient (°C/mV)
T_2 = high test temperature (°C)
T_1 = low test temperature (°C)
V_{F2} = forward voltage at T_2 (mV)
V_{F1} = forward voltage at T_1 (mV)

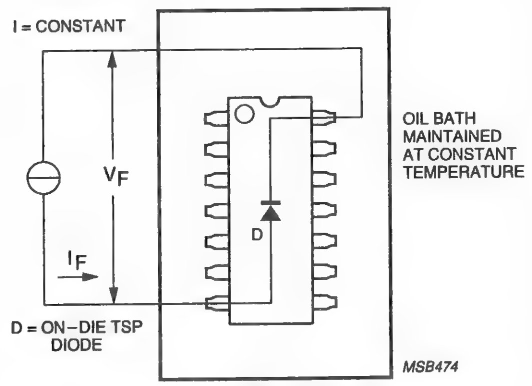


Fig.7.2 Test procedure

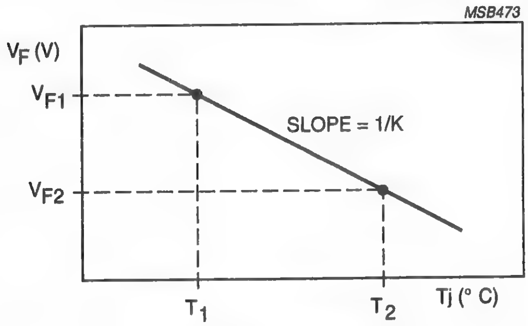


Fig.7.3 V_F as a function of T_J

With the K-factor determined, θ_{JA} can be calculated by powering up the device at ambient conditions and measuring the forward voltage drop across the TSP diode after temperature equilibrium. Manipulating the original thermal resistance equation with the K-factor, the θ_{JA} of the package can be determined:

$$\theta_{JA} = \frac{\Delta T_J}{P_D} = \frac{(T_J - T_A)}{P_D} = \frac{K\ (V_{FA} - V_{FS})}{V_H\ I_H}$$

Where: V_{FA} = forward voltage of TSP at ambient temperature (mV)
V_{FS} = forward voltage of TSP at steady-state temperature (mV)
V_H = heating voltage (V)
I_H = heating current (A)

FORCED AIR FACTORS FOR THERMAL RESISTANCE

Many applications of ICs have the benefit of forced air cooling by fans or other means. We determine the

thermal resistance at various levels of airflow by placing the test setup inside a wind tunnel (Fig.7.4). The average effect of airflow on thermal resistance for package types at a particular air flow rate can be determined using a "derating" graph (Fig.7.5). When using the derating curves, it's important to note that the variety of sizes in a package type group has been averaged. Please see the following section "Thermal Resistance Data – Assumptions and Precautions" concerning airflow.

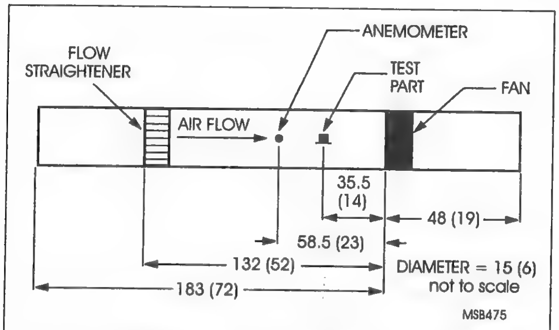


Fig.7.4 Wind tunnel - dimensions in cm (inches)

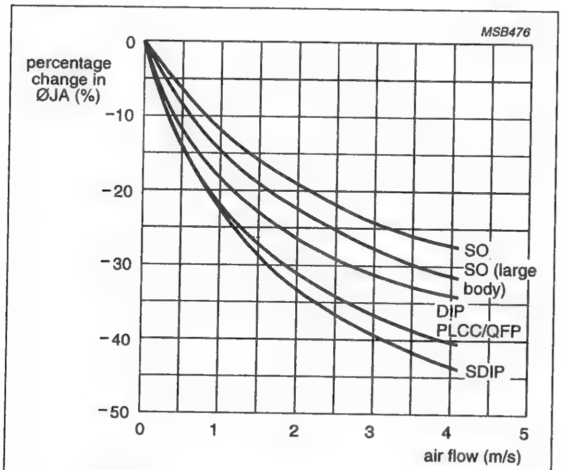


Fig.7.5 Average effect of airflow on θ_{JA}

THERMAL RESISTANCE DATA – ASSUMPTIONS AND PRECAUTIONS

The graphical data presented in this chapter are based on *measurements*, *modeling* and *estimations*. As with all data, some assumptions and contributing factors should be noted:

1. The "measured" thermal resistance of an IC package is highly dependent on the configuration and size of the test board. Data may not be comparable between different semiconductor manufacturers because the test boards and test methods are not yet standardized. Also, the thermal performance of packages for a specific application may be different than presented here because the configuration of the application boards may be different than the test boards. Philip Semiconductors uses FR-4 type test boards with 1 oz copper traces with solder coating.

2. Device standoff is a factor in determining thermal resistance especially for surface mounted packages such as SO and QFP packages. The same package from two different manufacturers will often have different standoff from the test boards. In general, high standoff corresponds to a higher thermal resistance.

3. The operating environment temperature must be used as the ambient temperature when calculating junction temperatures in an application. The temperatures inside an electronic enclosure are generally higher than the room temperature.

4. When using airflow derating curves (see Fig.7.5), please note that in actual applications where airflow is available, the flow dynamics may be more complex and turbulent than in a wind tunnel. Also, the many different sizes of packages in a package family such as QFP have been averaged to give one curve for ease-of-use. Lastly, the test boards used in the wind tunnel contribute significantly to forced convection heat transfer and may not be similar to an actual application PC board, especially its size.

5. Thermal resistance will vary slightly as a function of input power. Generally, as the power input increases, thermal resistance decreases. Thermal resistance changes approximately 5% for a 100% power change.

6. All thermal resistance data presented in the following pages are copper alloy lead framed packages only.

7. Thermal resistance data for some packages were not available at the time of publication. Please contact Philip Semiconductors for information on packages not listed in this handbook.

8. All data presented are accurate to approximately ±15%. For more specific information regarding an application, please contact Philip Semiconductors.

THERMAL RESISTANCE (θ_{JA}) DATA – DUAL IN-LINE PACKAGE (DIP)

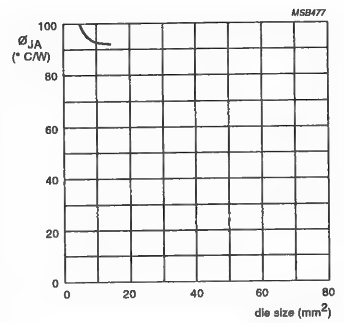


Fig.7.6 DIP8 (300 mil)

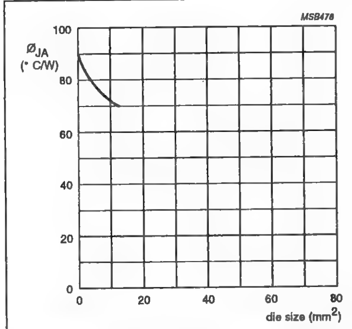


Fig.7.7 DIP14/16 (300 mil)

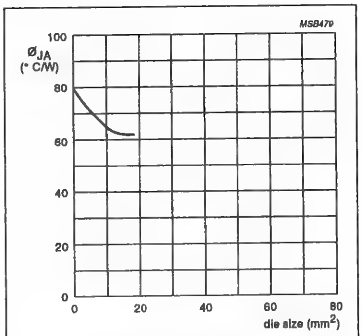


Fig.7.8 DIP18 (300 mil)

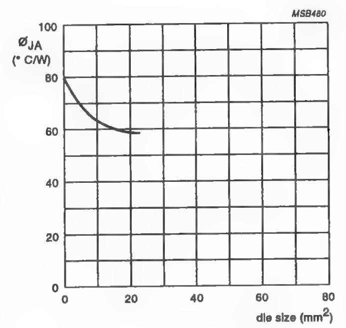


Fig.7.9 DIP20 (300 mil)

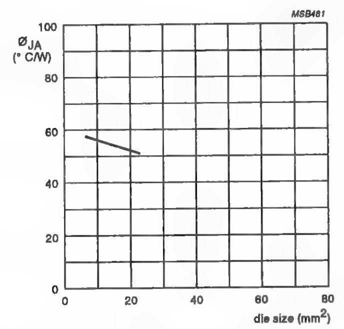


Fig.7.10 DIP22 (400 mil)

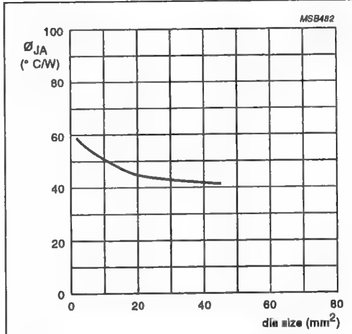


Fig.7.11 DIP24 (600 mil)

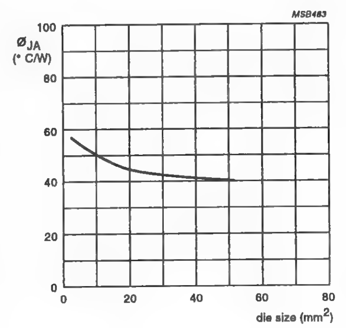


Fig.7.12 DIP28 (600 mil)

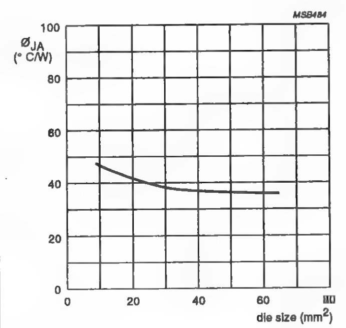


Fig.7.13 DIP40 (600 mil)

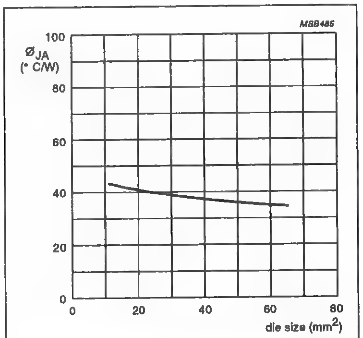


Fig.7.14 DIP48 (600 mil)

THERMAL RESISTANCE (θ_{JA}) DATA – SHRINK DUAL IN-LINE PACKAGE (SDIP)

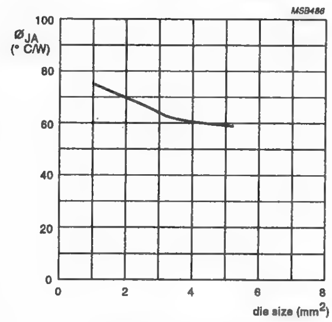


Fig.7.15 SDIP24

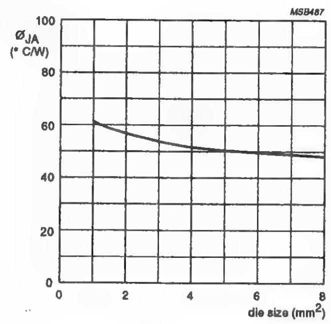


Fig.7.16 SDIP32

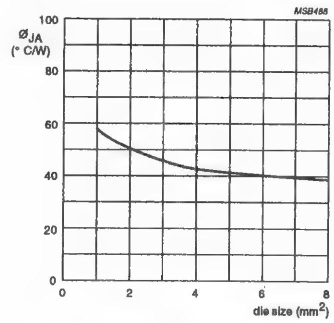


Fig.7.17 SDIP42

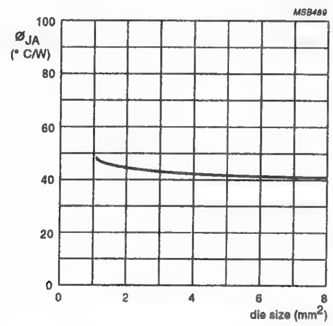


Fig.7.18 SDIP52

THERMAL RESISTANCE (θ_{JA}) DATA – PLASTIC LEADED CHIP CARRIER (PLCC)

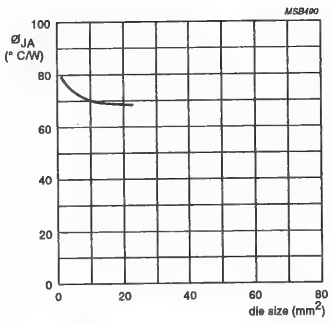


Fig.7.19 PLCC20

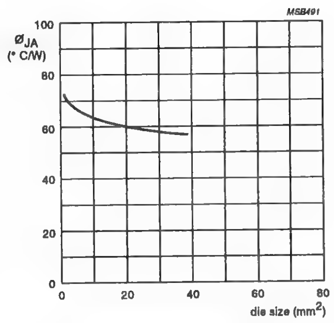


Fig.7.20 PLCC28

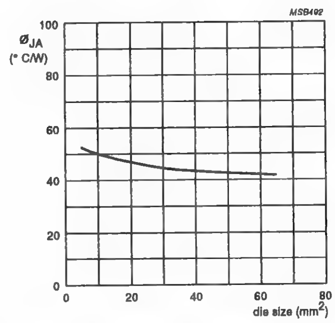


Fig.7.21 PLCC44

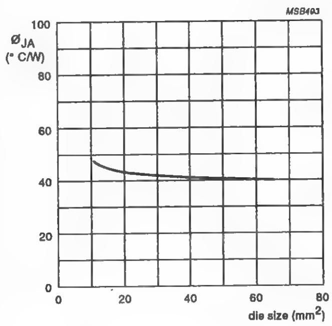


Fig.7.22 PLCC52

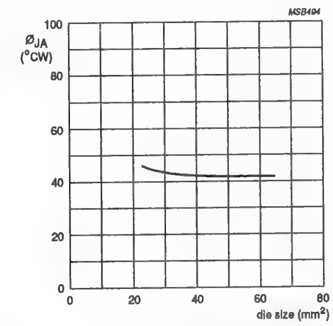


Fig.7.23 PLCC68

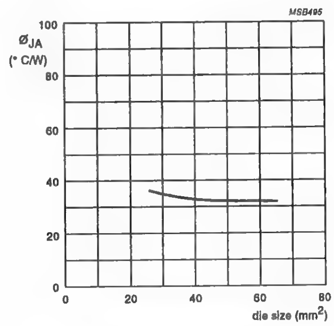


Fig.7.24 PLCC84

THERMAL RESISTANCE (θ_{JA}) DATA – QUAD FLAT PACKAGE (QFP)

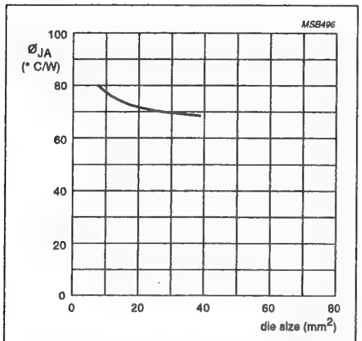


Fig.7.25 QFP44 (14 x 14 mm)

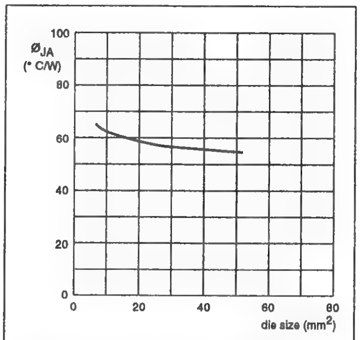


Fig.7.26 QFP64 (14 x 20 mm)

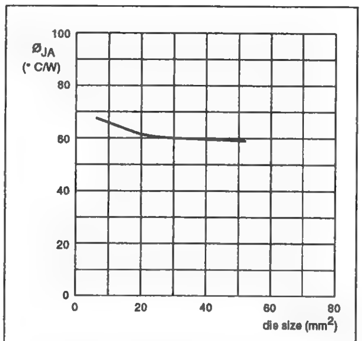


Fig.7.27 QFP80 (14 x 20 mm)

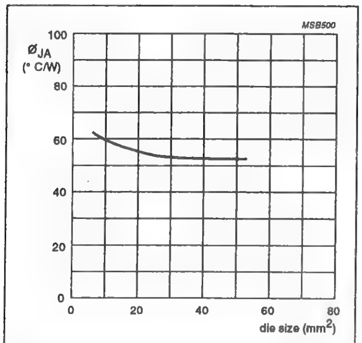


Fig.7.28 QFP100 (14 x 20 mm)

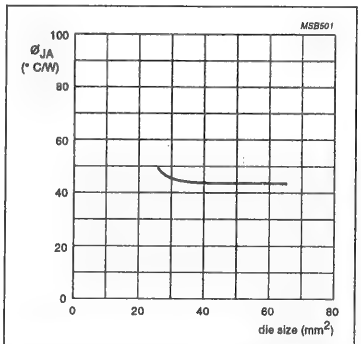


Fig.7.29 QFP120 (28 x 28 mm)

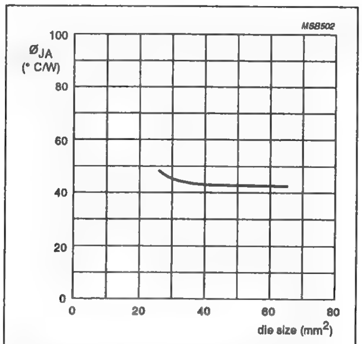


Fig.7.30 QFP128 (28 x 28 mm)

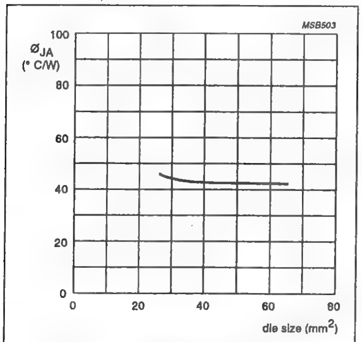


Fig.7.31 QFP160 (28 x 28 mm)

THERMAL RESISTANCE (θ_{JA}) DATA – SMALL OUTLINE PACKAGE (SO)

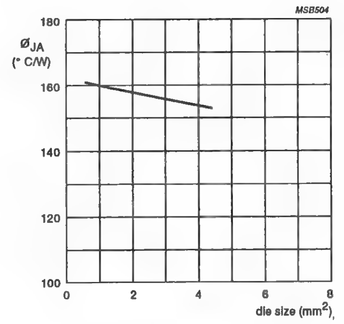


Fig.7.32 SO8

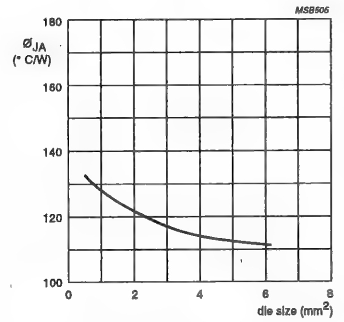


Fig.7.33 SO14

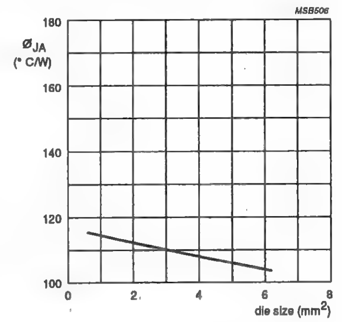


Fig.7.34 SO16

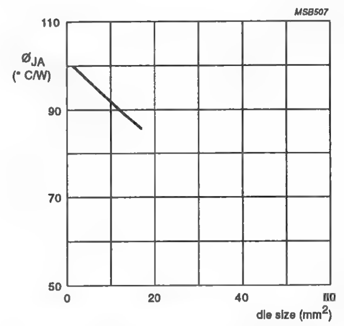


Fig.7.35 SO16 (large body)

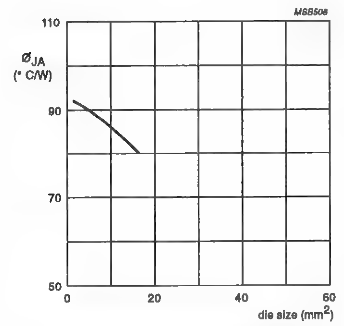


Fig.7.36 SO20 (large body)

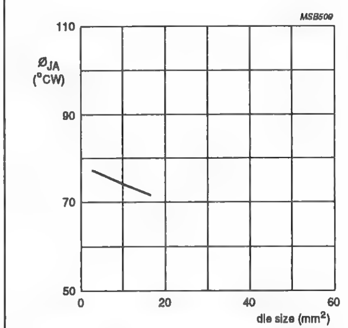


Fig.7.37 SO24 (large body)

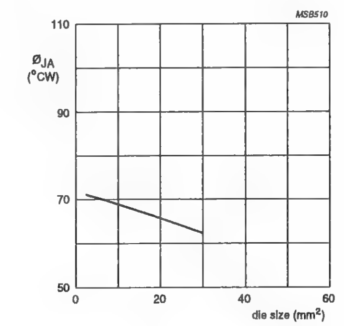


Fig.7.38 SO28 (large body)

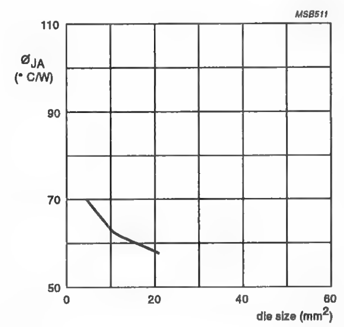


Fig.7.39 SO32 (large body)

THERMAL RESISTANCE (θ_{JA}) DATA - SHRINK SMALL OUTLINE PACKAGE (SSOP)

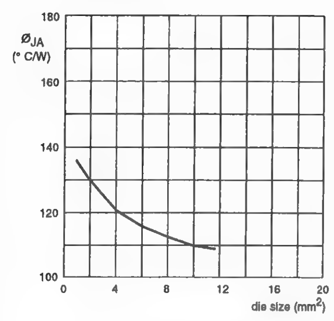


Fig.7.40 SSOP20

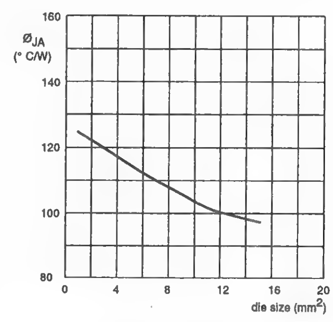


Fig.7.41 SSOP24

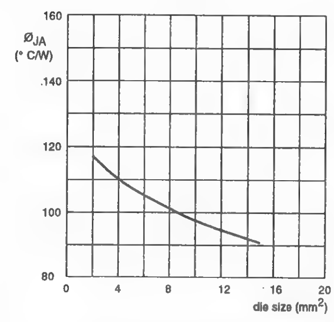


Fig.7.42 SSOP28

THERMAL RESISTANCE (θ_{JC}) DATA TABLES – POWER PACKAGES

Package name	Philips outline code	θ_{JC} (°C/W) Glued D/A	θ_{JC} (°C/W) Soldered D/A
SIL9MPF	SOT110-1	1.0 - 4.0	0.8 - 3.0
SIL9P	SOT131-2	1.0 - 4.0	0.8 - 3.0
SIL9MP	SOT142-1	1.0 - 4.0	0.8 - 3.0
SIL13P	SOT193-2	1.0 - 4.0	0.8 - 3.0
SMS9P	SOT354-1	1.0 - 4.0	0.8 - 3.0
DBS9MPF	SOT111-1	1.0 - 4.0	0.8 - 3.0
DBS9P	SOT157-2	1.0 - 4.0	0.8 - 3.0
DBS13P	SOT141-6	1.0 - 4.0	0.8 - 3.0
DBS17P	SOT243-1	1.0 - 4.0	0.8 - 3.0
RBS9MPF	SOT352-1	1.0 - 4.0	0.8 - 3.0

IC Packing Methods

This chapter contains a survey of some of the packing methods most frequently used by Philips Semiconductors and includes information that may be important to customers when making their purchasing decisions, for example the main dimensions, shapes, and packing quantities.

STANDARDIZATION

For semiconductors, packing serves two important functions. The first and most obvious function is protection during storage and transport to customers. This, of course, applies to all products, not just semiconductors. The second is to act as a delivery medium for automatic placement machines during equipment manufacture. To do this effectively, the reels, trays and tubes that ICs are packed in must meet recognized standards. In this respect, Philips Semiconductors actively cooperates with standardization authorities throughout the world. In addition, its packing methods meet all major international standards, including those of IEC (International Electrotechnical Commission), JEDEC (Joint Electron Device Engineering Council, USA) and NEDA (National Electronic Distributor Association, USA).

ENVIRONMENTAL CARE

Nowadays, an important issue attracting attention is environmental impact. Component and equipment manufacturers are continuously working to improve the environment friendliness of their products and packing, and have devoted much effort to eliminating the use of toxic materials and to looking at ways in which materials can be recycled. In these respects, Philips Semiconductors has taken several important steps on the packing front. These include:

- reducing the amount of packing material by switching to 'one piece' boxes (instead of boxes with upper and lower parts)
- changing to 'mono material' to aid recycling. For example, from aluminium-lined boxes to carbon-coated boxes
- changing from white boxes to natural brown boxes to eliminate the use of bleach (chlorine) in their manufacture.

The aim is minimum waste and minimum environmental impact. We've already gone a long way towards this in the development of our packing methods. And future developments will take us even further along this route.

For more information relating to environmental issues, refer to Chapter 9 – Chemical Content of ICs.

GLOSSARY OF TERMS

Through-hole	Mounted onto a PCB by insertion of leads into holes
Surface mount	Mounted on the surface of a PCB
Package	Container with leads for an IC chip (also known as an envelope or outline)
SOT	Standard Outline Transistor (used in the Philips outline code)
Carrier	Plastic tube, tray or tape with cavities, which can contain IC products
Packing method	Combination of a carrier and a box to protect products during transport and storage
Pin	Rigid plastic pin that closes a tube for DIP packages by insertion through holes in its end
Plug	Flexible plastic plug that closes a tube for PLCC or SIL packages by insertion into its end
Turnlock	Rigid plastic pin that closes a tube for SO packages by insertion into its end and turning to lock in place
SPQ	Smallest Packing Quantity, mostly the quantity in one carrier
PQ	Packing Quantity, in a box containing one or more SPQs

For a full definition of the package abbreviations and their suffixes, refer to Chapter 2 – IC Package Range and Dimensions.

AVAILABILITY IN CARRIER TYPE

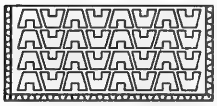
package name	carrier type		
	tube	tape/reel	tray
SIL	✓		
DBS	✓		
RBS	✓		
DIP	✓		
SO	✓	✓	
VSO	✓	✓	
SSOP	✓	✓	
PLCC	✓	✓	
QFP		✓	✓
TQFP		✓	✓
LQFP		✓	✓
SQFP			✓
TSSOP	✓	✓	

OVERVIEW OF BASIC PACKING METHODS

- Packing for DIP (tube/pin)
- Packing for PLCC/SIL (tube/plug)
- Packing for SO (tube/turnlock)
- Packing for SO/PLCC/QFP (tape/reel)
- Drypack for tube-packing
- Drypack for tape/reel-packing
- Drypack for tray-packing

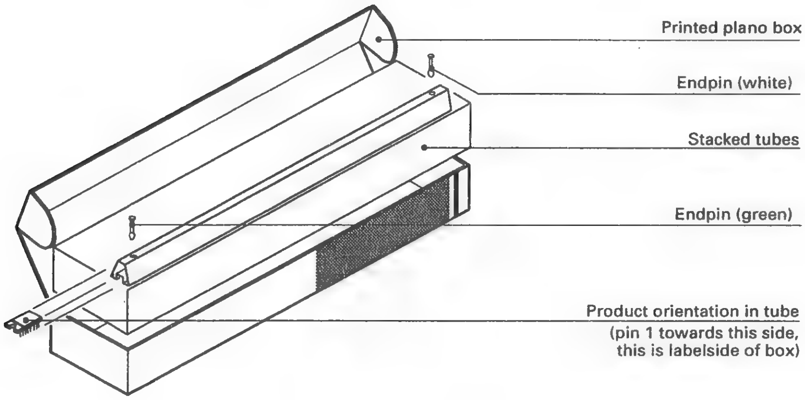
Exploded views of these packing methods are shown on pages 8–3 to 8–9.

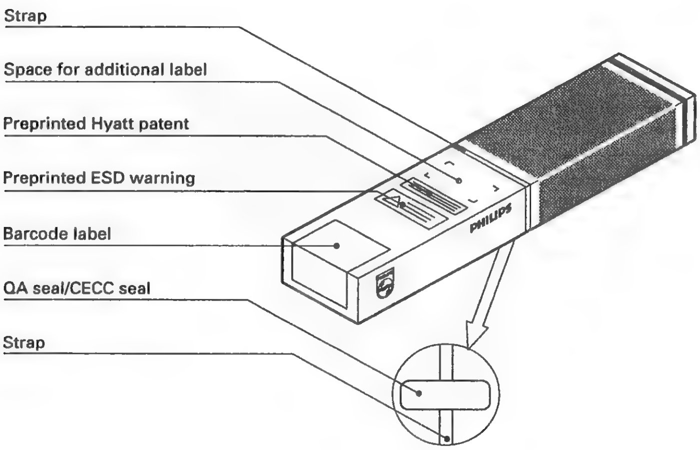
Packing for DIP (Tube/Pin)



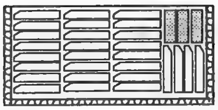
Stacking method

Item	Material	Weight (g)
Box	Cardboard carbon coated	145
Seal	Acrylate	0.2
Labels	Paper	1.65
Endstops	Poly Vinyl Chloride	9
Tubes	Poly Vinyl Chloride	800
Strap	Poly Propylene	0.7



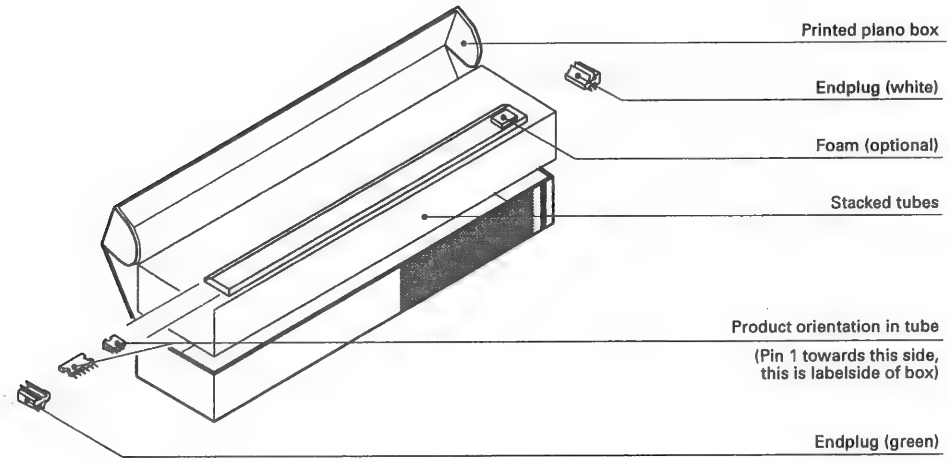


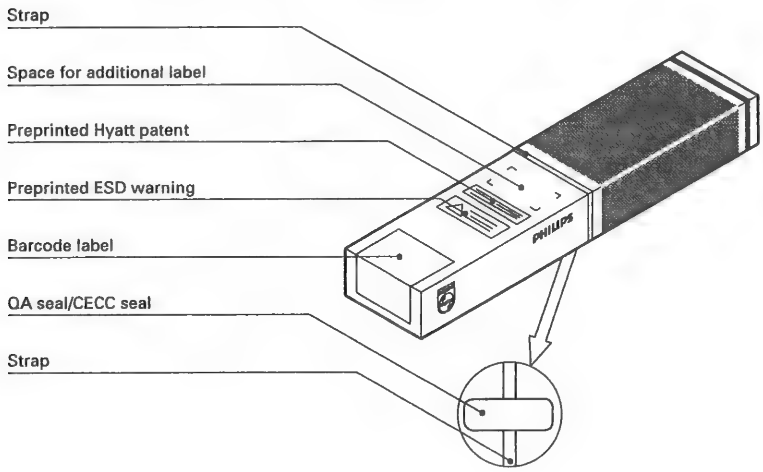
Packing for PLCC/SIL (Tube/Plug)



Stacking method

Item	Material	Weight (g)
Box	Cardboard carbon coated	145
Seal	Acrylate	0.2
Labels	Paper	1.65
Endstops	Poly Vinyl Chloride	128
Tubes	Poly Vinyl Chloride	1246
Strap	Poly Propylene	0.7
Foam	Poly Ethylene	13.5
Foam	Ethylene Vinyl Acetaat	1

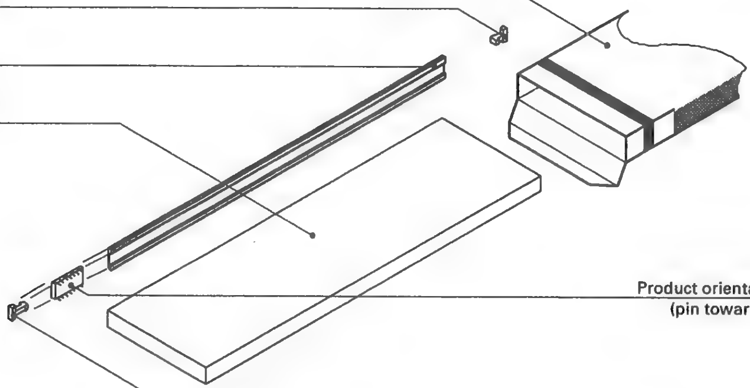


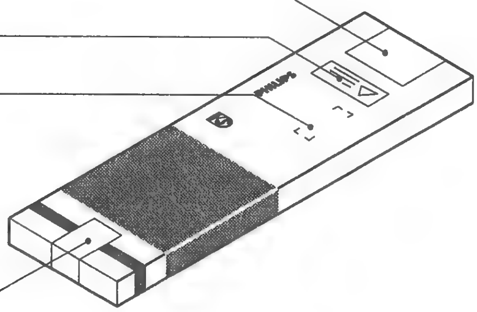


Packing for SO (Tube/Turnlock)

Item	Material	Weight (g)
Box	Cardboard carbon coated	61
Seal	Acrylate	0.2
Labels	Paper	1.65
Endstops	Poly Vinyl Chloride	4
Tubes	Poly Vinyl Chloride	172

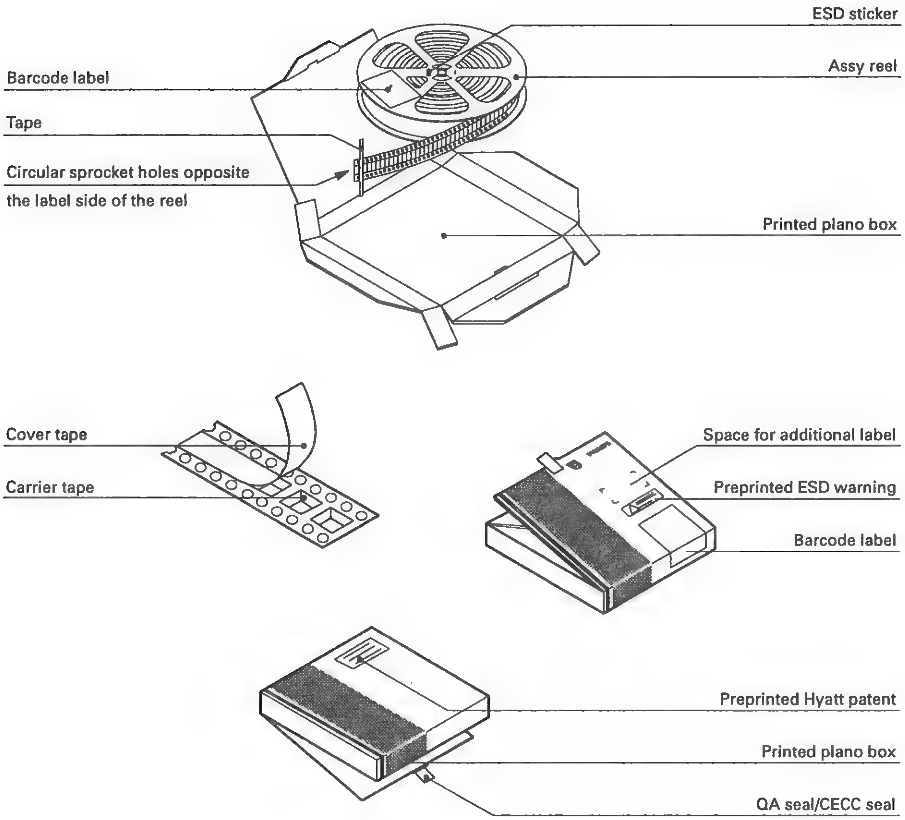
Stacking method



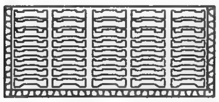


Packing for SO/PLCC/QFP (Tape/Reel)

Item	Material	Weight (g)
Box	Cardboard carbon coated	165
Reel	Poly Styrene	217
Covertape	Poly Ester	16
Carriertape	Poly Styrene	115
Seals	Acrylate	0.2
Tape	Paper	0.15
Labels	Paper	1.77

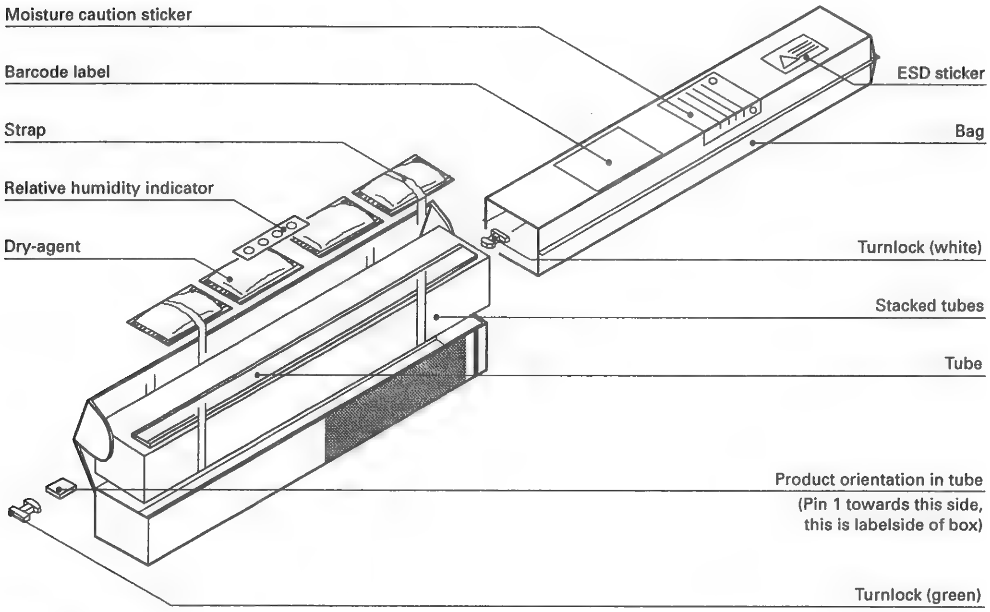


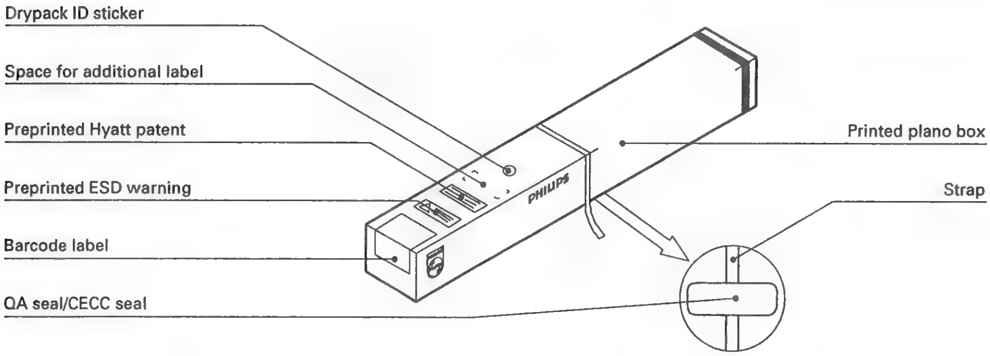
Drypack for Tube-Packing



Stacking method

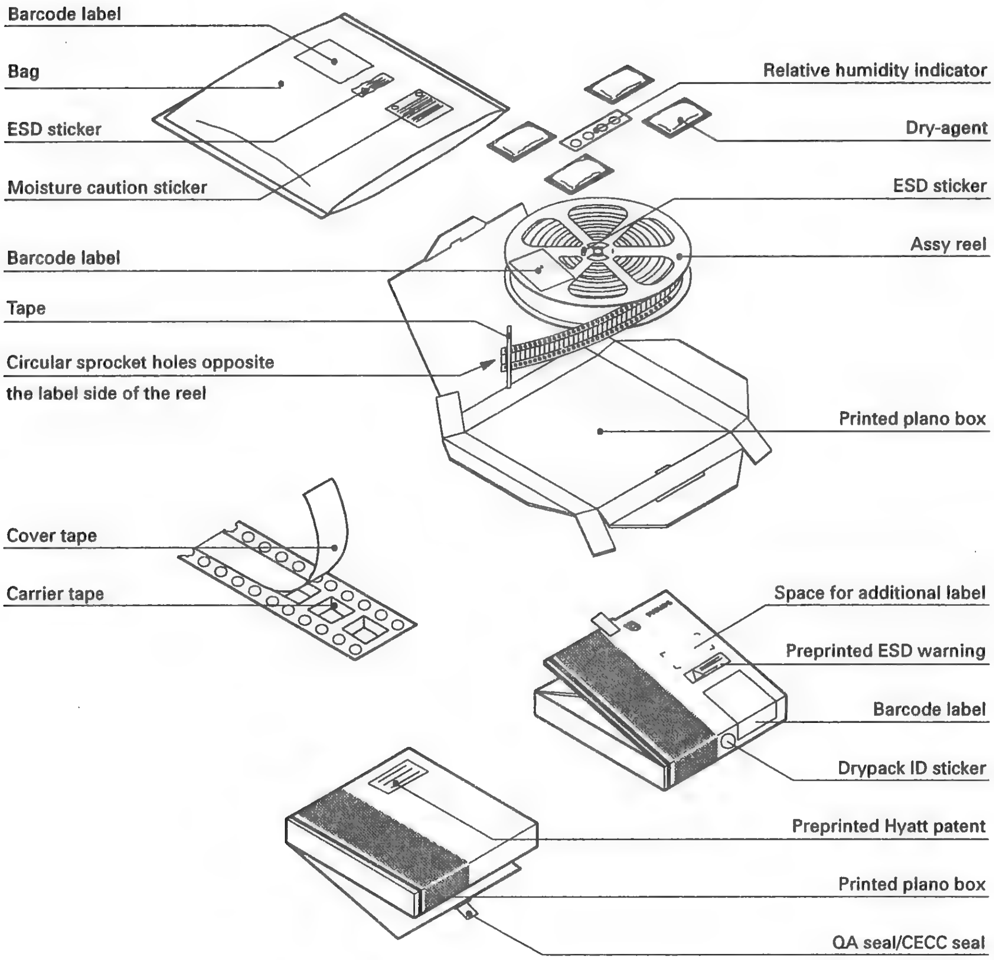
Item	Material	Weight (g)
Box	Cardboard	112
Tubes	Poly Vinyl Chloride	680
Endstops	Poly Vinyl Chloride	10
Bag	Aluminium/Poly Ethylene/Poly Olefine	38
Strap	Poly Propylene	0.6
Foam	Poly Ethylene	2
Labels	Paper	2.8
Dry-Agent	Amorphous Silicic Acid	88
Rel. Hum. Ind.	Paper+$CoCl_2$	1.15





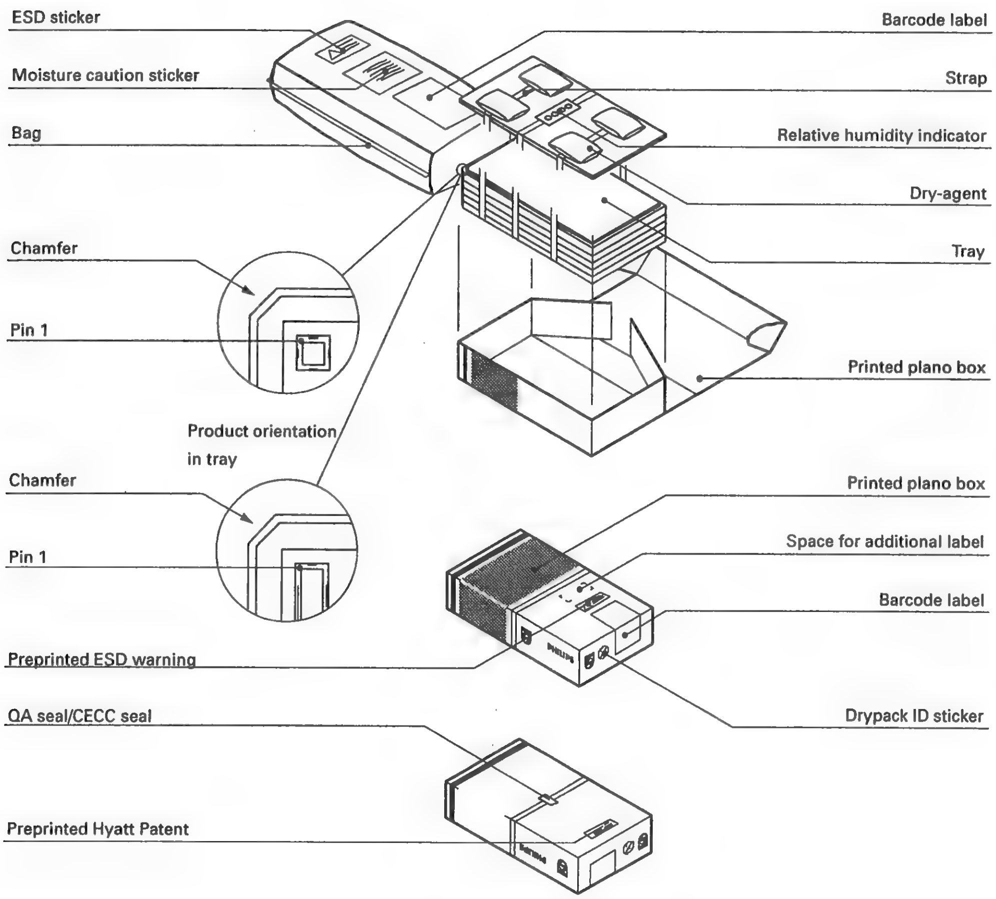
Drypack for Tape/Reel-Packing

Item	Material	Weight (g)
Box	Cardboard	203
Reel	Poly Styrene	217
Covertape	Poly Ester	165
Carriertape	Poly Styrene	16
Seals	Acrylate	0.2
Tape	Paper	0.15
Labels	Paper	3.66
Bag	Aluminium/Poly Ethylene/Poly Olefine	33
Dry-Agent	Amorphous Silicic Acid	88
Rel. Hum. Ind.	Paper+$CoCl_2$	1.15

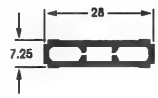
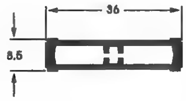
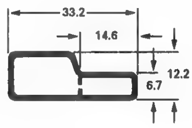
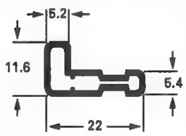
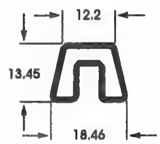
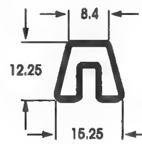


Drypack for Tray Packing

Item	Material	Weight (g)
Box	Cardboard	113
Tray Bakeable	Poly Acryl Sulfone (PAS) or	850
	Poly Ether Sulfone (PES)	850
Tray Non Bakeable	Fiber Glass Reinforced ABS	1050
Seal	Acrylate	0.15
Strap	Poly Propylene	2.2
Labels	Paper	2.55
Bag	Aluminium/Poly Ether/Poly Olefine	47
Dry-Agent	Amorphous Silicic Acid	88
Rel. Hum. Ind.	Paper + $CoCl_2$	1.15



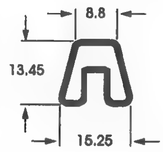
TUBE PACKING – THROUGH HOLE

package name	Philips package type/ outline code[1]	carrier length (mm)	end stop	SPQ	carriers per box	PQ	outer box dimensions (mm)	carrier profile
DBS9MPF	SOT111	501	plug	22	34	748	530×136×65	
SIL9MP	SOT142	501	plug	22	34	748	530×136×65	
SIL9MPF	SOT110	501	plug	22	34	748	530×136×65	
SIL9P	SOT131	575	plug	23	24	552	595×137×68	
SIL13P	SOT193	575	plug	23	24	552	595×137×68	
DBS9P	SOT157	575	plug	23	24	552	595×137×68	
DBS13P	SOT141	575	plug	23	24	552	595×137×68	
DBS17P	SOT243	575	plug	23	24	552	595x137x68	
RBS9MPF	SOT352	501	plug	22	42	924	530x136x65	
DIP22	SOT116	501	pin	17	32	544	530×136×65	
DIP22	SOT116	575	pin	21	40	840	595×137×68	
DIP24	SOT248	501	pin	15	32	480	530×136×65	
SDIP24	SOT234	575	pin	25	40	1000	595×137×68	
SDIP32	SOT232	575	pin	19	40	760	595×137×68	
DIP8	SOT97	501	pin	50	40	2000	532×142×63	

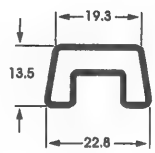
Note

1) If only a package type code is given, the data supplied is applicable to all its outline versions.

package name	Philips package type/ outline code[1]	carrier length (mm)	end stop	SPQ	carriers per box	PQ	outer box dimensions (mm)	carrier profile
DIP14	SOT27	501	pin	25	40	1000	532×142×63	
DIP16	SOT38-1	501	pin	22	40	880	532×142×63	
DIP16	SOT38-4	501	pin	25	40	1000	532×142×63	
DIP18	SOT102-1	501	pin	22	40	880	532×142×63	
DIP18	SOT102-2	501	pin	20	40	800	532×142×63	
DIP20	SOT146	501	pin	18	40	720	532×142×63	
SDIP20	SOT325	501	pin	25	40	1000	532×142×63	
DIP24	SOT222	501	pin	15	40	600	532×142×63	
DIP14	SOT27	575	pin	28	40	1120	595×137×68	
DIP16	SOT38-1	575	pin	25	40	1000	595×137×68	
DIP16	SOT38-4	575	pin	28	40	1120	595×137×68	
DIP18	SOT102-1	575	pin	25	40	1000	595×137×68	
DIP18	SOT102-2	575	pin	23	40	920	595×137×68	
DIP20	SOT146	575	pin	20	40	800	595×137×68	



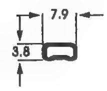
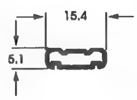
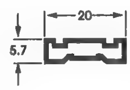
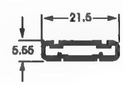
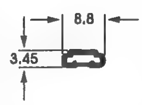
DIP24	SOT101	501	pin	15	24	360	532×142×63	
DIP28	SOT117	501	pin	13	24	312	532×142×63	
DIP32	SOT201	501	pin	11	24	264	532×142×63	
DIP40	SOT129	501	pin	9	24	216	532×142×63	
SDIP48	SOT270	501	pin	12	24	288	532×142×63	
DIP48	SOT240	501	pin	7	24	168	532×142×63	
SDIP52	SOT247	501	pin	10	24	240	532×142×63	
DIP24	SOT101	575	pin	17	30	510	595×137×68	
DIP28	SOT117	575	pin	15	30	450	595×137×68	
DIP32	SOT201	575	pin	13	30	390	595×137×68	
DIP40	SOT129	575	pin	10	30	300	595×137×68	
SDIP42	SOT270	575	pin	14	30	420	595×137×68	
SDIP52	SOT247	575	pin	11	30	330	595×137×68	



Note

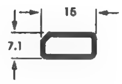
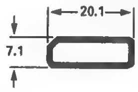
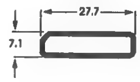
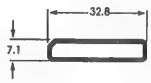
1) If only a package type code is given, the data supplied is applicable to all its outline versions.

TUBE PACKING – SURFACE MOUNT

package name	Philips package type/ outline code[1]	carrier length (mm)	end stop	SPQ	carriers per box	PQ	outer box dimensions		carrier profile
							non-drypacked (mm)	drypacked (mm)	
SO8	SOT96	515	turnlock	100	20	2000	525×83×15	528×101×23	
SO14	SOT108	515	turnlock	57	20	1140	525×83×15	528×101×23	
SO16	SOT109	515	turnlock	50	20	1000	525×83×15	528×101×23	
SO8	SOT176	511	turnlock	64	40	2560	551×90×46	572×94×54	
SO16	SOT162	511	turnlock	47	40	1880	551×90×46	572×94×54	
SO20	SOT163	511	turnlock	38	40	1520	551×90×46	572×94×54	
SO24	SOT137	511	turnlock	31	40	1240	551×90×46	572×94×54	
SO28	SOT136	511	turnlock	27	40	1080	551×90×46	572×94×54	
SO32	SOT287	511	turnlock	24	40	960	551×90×46	572×94×54	
VSO40	SOT158	511	turnlock	31	40	1240	551×90×46	572×94×54	
SO28	SOT213	511	turnlock	27	28	756	551×90×46	572×94×54	
VSO56	SOT190	495	turnlock	22	28	616	551×90×46	572×94×54	
SSOP20	SOT266	511	turnlock	75	18	1350	525×83×20	530×103×29	
SSOP20	SOT339	508	plug	66	14	924	525×83×20	530×103×29	
SSOP24	SOT340	508	plug	59	14	826	525×83×20	530×103×29	
SSOP36	SOT378	508	plug	32	40	1280	–	572×94×54	

Note

1) If only a package type code is given, the data supplied is applicable to all its outline versions.

package name	Philips package type/ outline code[1]	carrier length (mm)	end stop	SPQ	carriers per box	PQ	outer box dimensions non-drypacked (mm)	outer box dimensions drypacked (mm)	carrier profile
PLCC28	SOT261	491	plug	34	64	2176	532×142×63	–	
PLCC44	SOT187	491	plug	26	50	1300	532×142×63	541×129×67	
PLCC68	SOT188	491	plug	18	36	648	532×142×63	541×129×67	
PLCC84	SOT189	491	plug	15	28	420	532×142×63	541×129×67	

Note

1) If only a package type code is given, the data supplied is applicable to all its outline versions.

TAPE & REEL – SURFACE MOUNT

package name	Philips package type/ outline code[1]	carrier dimensions D × W (mm)	SPQ & PQ	outer box dimension non-drypacked (mm)	outer box dimension drypacked (mm)
SO8	SOT96	180×12	1000	191×188×26	209×206×36
SO8	SOT96	330×12	2500	341×338×26	369×366×36
SO8	SOT176	180×16	500	191×188×30	209×206×40
SO8	SOT176	330×16	1000	341×338×30	369×366×40
SO14	SOT108	180×16	1000	191×188×30	209×206×40
SO14	SOT108	330×16	2500	341×338×30	369×366×40
SO16	SOT109	180×16	1000	191×188×30	209×206×40
SO16	SOT109	330×16	2500	341×338×30	369×366×40
SO16	SOT162	180×16	500	191×188×30	209×206×40
SO16	SOT162	330×16	1000	341×338×30	369×366×40
SO20	SOT163	180×24	500	191×188×39	209×206×48
SO20	SOT163	330×24	1000	341×338×39	369×366×48
SO24	SOT137	180×24	500	191×188×39	209×206×48
SO24	SOT137	330×24	1000	341×338×39	369×366×48
SO28	SOT136	180×24	500	191×188×39	209×206×48
SO28	SOT136	330×24	1000	341×338×39	369×366×48
SO28	SOT213	180×24	350	191×188×39	209×206×48
SO28	SOT213	330×24	1000	341×338×39	369×366×48
VSO40	SOT158	180×24	300	191×188×39	209×206×48
VSO40	SOT158	330×24	1000	341×338×39	369×366×48
VSO56	SOT190	360×32	1000	371×368×48	394×391×58
SSOP20	SOT266	180×16	1000	191×188×30	209×206×40
SSOP20	SOT266	330×16	2500	341×338×30	369×366×40
PLCC28	SOT261	180×24	300	191×188×39	209×206×48
PLCC28	SOT261	330×24	750	341×338×39	369×366×48
PLCC44	SOT187	330×32	500	341×338×49	369×366×56
PLCC44	SOT187	360×32	500	371×368×48	394×39×58
PLCC68	SOT188	330×44	250	341×338×61	369×366×68
PLCC68	SOT188	360×44	250	369×368×61	380×378×70
PLCC84	SOT189	330×44	250	341×338×61	369×366×68
PLCC84	SOT189	360×44	250	369×368×61	380×378×70

Note

1) If only a package type code is given, the data supplied is applicable to all its outline versions.

package name	Philips package type/ outline code[1]	carrier dimensions D × W (mm)	SPQ & PQ	outer box dimension non-drypacked (mm)	outer box dimension drypacked (mm)
QFP44	SOT307	330x24	1500	341x338x39	369x366x48
QFP44	SOT205	360x32	1000	371x368x48	380x378x58
QFP64	SOT319	360x44	500	369x368x61	380x378x70
QFP80	SOT318	360x44	500	369x368x61	380x378x70
QFP100	SOT317	360x44	500	369x368x61	380x378x70
LQFP32	SOT358	330x16	2000	341x338x30	369x366x40
LQFP48	SOT313	330x16	2000	341x338x30	369x366x40
LQFP80	SOT315	330x24	1000	341x338x39	369x366x48
TSSOP14	SOT402	330x12	2500	341x338x26	369x366x36
TSSOP16	SOT403	330x12	2500	341x338x26	369x366x36
TSSOP20	SOT360	330x16	2500	341x338x30	369x366x40
TSSOP24	SOT355	330x16	2500	341x338x30	369x366x40
TSSOP48	SOT362	330x24	2000	341x338x39	369x366x48
TSSOP56	SOT364	330x24	2000	341x338x39	369x366x48

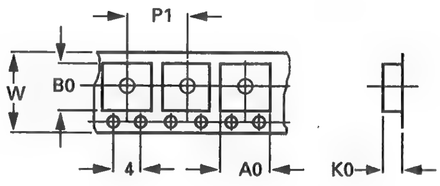
Note

1) If only a package type code is given, the data supplied is applicable to all its outline versions.

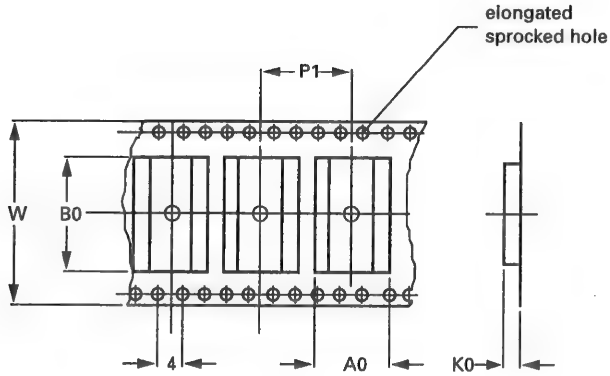
package name	Philips package type/ outline code[1]	carrier tape dimensions in mm (see figure on page 8–17)					
		A0	B0	K0	P1	W	type
SO8	SOT96	6.65	5.4	1.8	8	12	A
SO8	SOT176	10.5	8.0	3.0	12	16	A
SO14	SOT108	6.65	9.65	1.8	8	16	A
SO16	SOT109	6.65	10.45	1.8	8	16	A
SO16	SOT162	11.1	10.95	2.7	12	16	A
SO20	SOT163	11.1	13.5	2.7	12	24	A
SO24	SOT137	11.1	16.1	2.7	12	24	A
SO28	SOT136	11.1	18.5	2.7	12	24	A
SO28	SOT213	12.8	18.0	3.05	16	24	A
VSO40	SOT158	12.8	16.3	3.0	16	24	A
VSO56	SOT190	16.0	22.3	3.15	20	32	B
PLCC28	SOT261	13.0	13.0	4.9	16	24	A
PLCC44	SOT187	18.0	18.0	5.7	24	32	B
PLCC68	SOT188	25.6	25.6	5.8	32	44	B
PLCC84	SOT189	30.7	30.7	5.8	36	44	B
QFP44	SOT307	13.1	13.1	2.4	16.0	24.0	A
QFP44	SOT205	19.2	19.2	3.0	24.0	32.0	B
QFP64	SOT319	19.0	25.0	3.7	32.0	44.0	B
QFP80	SOT318	19.0	25.0	3.7	32.0	44.0	B
QFP100	SOT317	19.0	25.0	3.7	32.0	44.0	B
LQFP32	SOT358	9.6	9.6	2.2	12.0	16.0	A
LQFP48	SOT313	9.6	9.6	2.2	12.0	16.0	A
LQFP80	SOT315	14.4	14.4	2.1	20.0	24.0	A
TSSOP14	SOT402	6.95	5.6	1.6	8.0	12.0	A
TSSOP16	SOT403	6.95	5.6	1.6	8.0	12.0	A
TSSOP20	SOT360	6.9	10.6	1.8	12.0	16.0	A
TSSOP24	SOT355	6.9	11.8	1.8	12.0	16.0	A
TSSOP48	SOT362	8.35	13.0	1.6	16.0	24.0	A
TSSOP56	SOT364	8.6	14.5	1.8	12.0	24.0	A

Note

1) If only a package type code is given, the data supplied is applicable to all its outline versions.



Type A



Type B

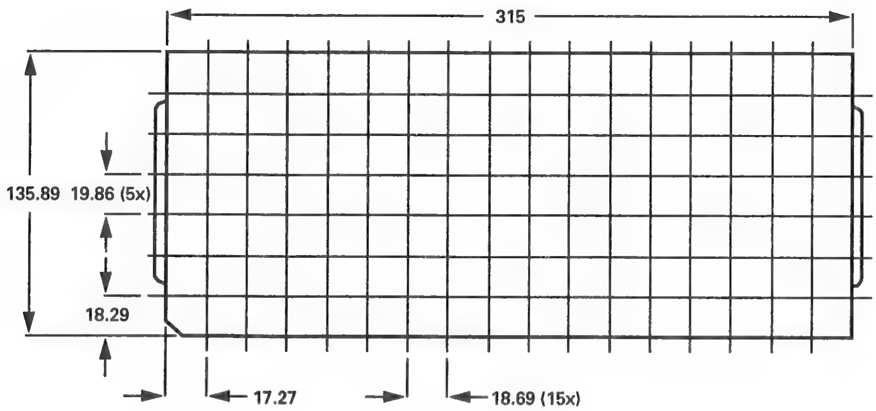
TRAYS (DRYPACKED) – SURFACE MOUNT

package name	Philips package type/ outline code[1)]	carrier dimensions L × W × H (mm)	SPQ & PQ	carriers per box	outer box dimensions (mm)	Remarks
QFP44	SOT307	315×135.9×7.6	96	1	352×183×27	QFP–10×10 mm
QFP44	SOT205	315×135.9×7.6	84	1	352×183×27	QFP–14×14 mm
QFP52	SOT379	315×135.9×7.6	96	1	352×183×27	QFP–10×10 mm
QFP64	SOT319	315×135.9×7.6	66	1	352×183×27	QFP–14×20 mm
QFP80	SOT318	315×135.9×7.6	66	1	352×183×27	QFP–14×20 mm
QFP100	SOT317	315×135.9×7.6	66	1	352×183×27	QFP–14×20 mm
QFP120	SOT349	315×135.9×7.6	24	1	352×183×27	QFP–28×28 mm
QFP128	SOT320	315×135.9×7.6	24	1	352×183×27	QFP–28×28 mm
QFP160	SOT322	315×135.9×7.6	24	1	352×183×27	QFP–28×28 mm
SQFP208	SOT316	315×135.9×7.6	24	1	352×183×27	QFP–28×28 mm
LQFP32	SOT358	315×135×7.0	250	1	352×183×27	LQFP–7×7 mm
LQFP48	SOT313	315×135×7.0	160	1	352×183×27	LQFP–7×7 mm
LQFP80	SOT315	315×135×7.0	119	1	352×183×27	LQFP–12×12 mm
QFP44	SOT307	315×135.9×7.6	480	5	356×161×56	QFP–10×10 mm
QFP44	SOT205	315×135.9×7.6	420	5	356×161×56	QFP–14×14 mm
QFP52	SOT379	315×135.9×7.6	480	5	356×161×56	QFP–10×10 mm
QFP64	SOT319	315×135.9×7.6	330	5	356×161×56	QFP–14×20 mm
QFP80	SOT318	315×135.9×7.6	330	5	356×161×56	QFP–14×20 mm
QFP100	SOT317	315×135.9×7.6	330	5	356×161×56	QFP–14×20 mm
QFP120	SOT349	315×135.9×7.6	120	5	356×161×56	QFP–28×28 mm
QFP128	SOT320	315×135.9×7.6	120	5	356×161×56	QFP–28×28 mm
QFP160	SOT322	315×135.9×7.6	120	5	356×161×56	QFP–28×28 mm
SQFP208	SOT316	315×135.9×7.6	120	5	356×161×56	QFP–28×28 mm
LQFP32	SOT358	315×135×7.0	1250	5	356×161×56	LQFP–7×7 mm
LQFP48	SOT313	315×135×7.0	800	5	356×161×56	LQFP–7×7 mm
LQFP80	SOT315	315×135×7.0	595	5	356×161×56	LQFP–12×12 mm

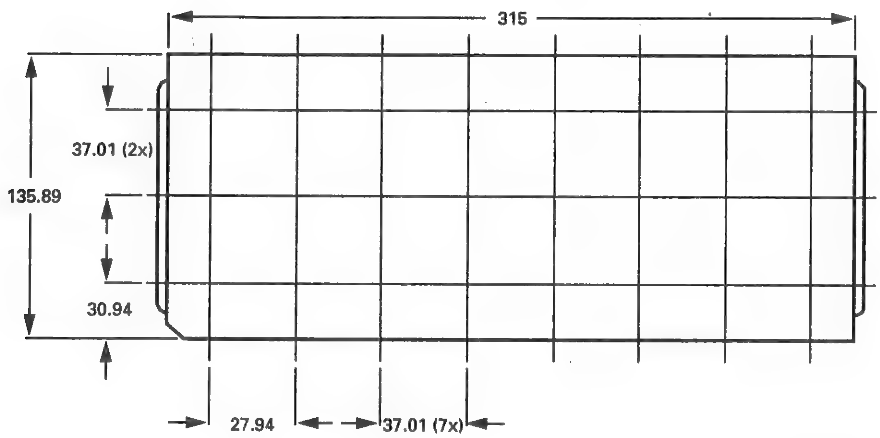
Note

1) If only a package type code is given, the data supplied is applicable to all its outline versions.

TRAY DIMENSIONS



Tray for 10x10 package



Tray for 28x28 package

CHAPTER 9
Chemical Content of ICs

Nowadays, everyone must accept responsibility for keeping the environment clean, from individuals adopting a responsible attitude to their own waste disposal, however small that may be, to big industries who must take proper precautions to avoid releasing large amounts of damaging waste into the environment.

As a leading electronic components manufacturer, Philips Semiconductors has always regarded environmental protection as a major issue. The electronics industry, like many others, produces its share of toxic and hazardous materials, and we have long made it our policy to follow working practices that cut the chance of these materials passing into the environment to the absolute minimum.

Products supplied by Philips Semiconductors today offer no hazard to the environment in normal operation and when stored according to the instructions given in our data sheets. Inevitably, some products contain substances that are potentially hazardous to health if exposed by accident or misuse, but we ensure that users of these components receive clear warning of this in the data sheets. And where necessary, the warning notices contain safety precautions and disposal instructions.

This Chapter supplements these notices and instructions by providing clear and comprehensive information on the composition of representative examples of ICs manufactured by Philips Semiconductors. This information should form a basis for answering questions on product safety and disposal and should, moreover, help to increase awareness of these aspects, not only throughout the Philips Semiconductors organization but throughout the semiconductor industry in general.

EXPLANATION TO THE TABLES

The following pages provide the chemical constituents of representative groups of ICs down to minor percentages and traces, as far as these constituents may be important to the use, destruction or disposal of the devices.

The tables contain information about the materials used in the IC devices themselves and in the packing used for storage, transport and assembly.

Whenever possible, the devices have been grouped into families based on the similarity in composition, construction and packing method. In this way we were able to limit the number of tables. For each group, one representative is specified in mass percentages of its parts.

In many cases, a single envelope type will contain a range of differing leadframes with different die-pad dimensions to accommodate the active devices. This, however, leads to only minor changes in the mass percentages. Different materials or techniques are sometimes used to assemble one envelope type, and whenever possible, alternative materials are included in the tables. In other cases only the standard or high-volume process is described.

ICs are grouped into package family and listed with Philips package type code (SOT number), the package name, mass (grams) and body dimensions (mm).

The table itself shows the composition of the group representative broken down into the device-parts:

- metal parts
- crystal
- envelope
- packing materials

Information on most of our ICs is given on the following pages, however, for types not covered (e.g. all ceramic types) data can be provided on request.

The packing quantity (PQ) is the number of devices packed per unit (box or reel). Generally, packing methods are available for more than one PQ. The amount of packing material, specified in grams, per device can be found by dividing the weight of the packing material by PQ. For more detailed information on packing, refer to Chapter 8 – IC Packing Methods.

The amounts of the other device-parts are specified in percentage of the mass of one device. These figures are as accurate as possible, but may deviate when other materials are used in the assembly. Large deviations may occur when the figures are used for other devices of the same group.

DEVICE-PARTS

Metal parts

The composition of the leadframe material is indicated, when appropriate, by the method commonly used for alloys, e.g.:

- FeNi42 means iron alloy containing 42% of nickel (alloy 42).
- CuZn15 means copper alloy containing 15% zinc (tombac).
- Cu alloy indicates copper with a small amount of alloying elements such as Fe, Ni, Zn or Ag or combinations of some elements.

Crystal

The active device is usually a silicon chip doped with very small amounts of elements such as boron, arsenic or phosphorus. The back may be metallized with thin layers of titanium, nickel, platinum, gold or silver to enhance die-bonding to the leadframe.

Envelope
The chip is protected by a plastic or ceramic encapsulation.

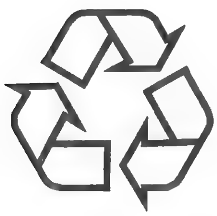
The plastic encapsulation is usually transfer-moulded epoxy novolac resin, filled with quartz particles (fused or crystalline) up to approximately 70 mass percent. In most cases antimony trioxide and tetrabromobisphenol-A (TBBA) are present as flame retardants. The TBBA will be incorporated in the epoxy-polymer after curing so that no TBBA is present in the finished device. In the tables, it is therefore referred to as partially brominated epoxy. The amount of bromium in the epoxy is ≈ 1%. Antimony trioxide content may vary between 1-3%.

Packing material
Cardboard and paper consist mainly of natural fibres. Aluminium laminated cardboard has been replaced by carbon coated material to facilitate recycling of the cardboard.

Polyethylene, polypropylene and polystyrene are synthetic polymers, made from hydrocarbons. Expanded polystyrene or polyethylene are produced by blowing with steam or nitrogen.

Polyvinylchloride (PVC), a synthetic polymer made from chlorinated hydrocarbons, is used for the tubes in which many semiconductors are packed. PVC is hazardous to the environment when burned under certain, ill-controlled conditions. Recyclability of PVC, however, is good when the material is collected separately (as a mono-material). Yet PVC has been replaced by other materials or alternatives are still under study (in the case of tubes for packing certain types of semiconductors).

To encourage recycling, Philips Semiconductors marks all polymers used in packing materials according to ISO 11469 using the recycling symbols shown below:



Paper and cardboard

Plastics

SUBSTANCES NOT USED BY PHILIPS SEMICONDUCTORS
Below are listed the materials and substances that are **not** present in Philips Semiconductors' products and processes. This information supplements the chemical contents tables that follow and is provided to enable equipment manufacturers to make a complete and confident assessment of the environmental impact of selecting products manufactured by Philips Semiconductors.

Substances not used in products
- 4-aminodiphenyl and its salts
- ammonium salts
- arsenic
- asbestos
- benzene
- cadmium and compounds
- cyanates
- cyanides
- 4,4-diaminophenyl methane
- dibenzofurans
- epichlorhydrine
- ethylene glycol ethers
- formaldehyde
- halogenated aliphatic hydrocarbons
- hydrazine
- mercury and compounds
- N-nitrosoamines
- 2-naphthylamine and its salts
- nickel tetracarbonyl
- N,N-dimethlformamide
- N,N-dimethylacetamide
- oils and greases
- organometallic compounds
- ozone-depleting compounds
- pentachlorophenol
- phenol compounds
- picric acid
- polybrominated biphenyl oxides (PBBO)
- polybrominated biphenyls (PBB/PBBE)
- polychlorinated triphenyls (PCT)
- polychlorinated napthalenes
- polychlorinated biphenyls (PCB)
- polycyclic compounds
- polyhalogenated dibenzofurans/dioxins
- polyhalogenated bi/triphenyl ethers
- selenium
- tellurium
- tetrabromobenzylimidazole
- tetrabromoethylene
- toluene
- triethylamine
- tris (aziridinyl) phosphinoxide
- tris (2,3-dibromopropyl) phosphate
- vinyl chloride monomer
- xylene

Substances not used in manufacturing processes

- CFCs and halons
- Class I substances according to the USA Clean-Air Act

Substances not used in packing materials

- Laminates with paper
- Chlorine-bleached paper

DISPOSAL

Old or used products must be disposed of in accordance to national and local regulations.

The products and packing materials must be disposed of as special waste. This is required, in particular, for parts containing environmentally hazardous materials.

Smaller quantities of material may be disposed of as domestic waste, provided national or local regulations permit this.

RECYCLING

Where legally required, we accept packing materials and products for recycling and/or disposal. However, since the cost of returning these materials to us must be borne by the customers, it is often more cost effective for them to look for a local recycle company. To assist in this we can provide customers with the names and addresses of local recycle companies in their areas.

GENERAL WARNINGS

Products

Under the specified operating conditions, no hazardous materials will be liberated from the products. The general warnings describe phenomena that can be expected with **abnormal** use (outside the product's specification). For example:

- If a product is exposed to strong acids, metals contained within it may be partially extracted.
- If a product with an epoxy moulded envelope is exposed to organic solvents, these may extract part of the resin contained in the envelope.
- If the product is incinerated, degradation and condensation reactions in the organic material it contains may cause a number of hazardous substances to be released into the air in unpredictable amounts. Moreover, metal oxides will be formed and may be released into the air as dust particles.

Packing material

- With adequate oxygen supply, packing materials will give off mainly carbon dioxide and water if burned. However, if they are burned in a limited oxygen supply (the general case in a fire), hazardous compounds (for example carbon monoxide) may be emitted.
- PVC will form hydrochloric acid gas when incinerated. It will also generate a number of other chlorine compounds, among them the toxic dioxin, when the conditions (temperature, oxygen) are not well controlled.

DUAL IN-LINE PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT97	DIP8	0.480	6.4 × 9.3 × 3.2
SOT27	DIP14	0.970	6.4 × 19.0 × 3.2
SOT38	DIP16	1.180	6.4 × 19.0 × 3.2
SOT102	DIP18	1.180	6.4 × 21.6 × 3.7
SOT146	DIP20	1.340	6.4 × 26.6 × 3.2
SOT116	DIP22	2.213	8.9 × 28.0 × 3.8
SOT101	DIP24	3.800	13.8 × 31.7 × 4.0
SOT117	DIP28	4.336	13.8 × 35.7 × 4.0
SOT201	DIP32	4.682	14.0 × 41.1 × 4.0
SOT129	DIP40	6.214	13.8 × 52.0 × 4.0
SOT240	DIP48	7.700	14.0 × 61.7 × 4.0

All DIP packages have a similar composition, quantities may vary

Chemical content Group representative: SOT129 (DIP40)

SOT129	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	FeNi42 or Cu alloy, Ag spot plated	20.8	
	solder layer	Sn or Sn/Pb	0.3	
crystal	active device	doped Si	0.5	
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	78.4	
Packing material			(g)	PQ = 216
tube pack	box	cardboard, carbon coated	145	
	tubes	polyvinylchloride	960	24 tubes/box
	end pins	polyamide	5.6	
	foam	polyethylene	8.3	
	strap	polypropylene	0.7	
	stickers	paper	1.7	
	seal	acrylate	0.2	

SHRINK DUAL IN-LINE PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT325	SDIP20	0.93	6.4 × 19.0 × 3.2
SOT234	SDIP24	1.65	8.9 × 21.9 × 3.8
SOT232	SDIP32	2.2	8.9 × 29.0 × 3.8
SOT270	SDIP42	4.57	13.8 × 38.6 × 4.6
SOT247	SDIP52	5.55	13.8 × 47.5 × 4.0
SOT274	SDIP64	9.15	17.0 × 58.2 × 4.6

All SDIP packages have a similar composition, quantities may vary

Chemical content

Group representative: SOT270 (SDIP42)

SOT270	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	Cu alloy, Ag spot plated	21.9	
	solder layer	Sn or Sn/Pb	0.5	
crystal	active device	doped Si	1.1	
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	75.9	
Packing material			(g)	PQ = 420
tube pack	box	cardboard, carbon coated	145	
	tubes	polyvinylchloride	1200	30 tubes/box
	end pins	polyamide	6.8	
	foam	polyethylene	8.3	
	strap	polypropylene	1	
	sticker	paper	1.7	
	seal	acrylate	0.2	

SINGLE IN-LINE MEDIUM POWER PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT111	DBS9MPF	1.75	6.4 × 21.6 × 3.5
SOT352	RBS9MPF	1.75	6.4 × 21.6 × 3.5
SOT142	SIL9MP	1.39	6.4 × 21.6 × 3.5
SOT110	SIL9MPF	1.75	6.4 × 21.6 × 3.5

All single in-line medium power type packages have a similar composition, quantities may vary

Chemical content Group representative: SOT110 (SIL9MPF)

SOT110	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	Cu alloy, Ag spot plated	56.8	
	solder layer	SnPb20	0.3	
crystal	active device	doped Si	0.5	
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	42.4	
Packing material			(g)	PQ = 748
tube pack	box	cardboard, carbon coated	145	
	tubes	polyvinylchloride	1925	34 tubes/box
	end plugs	polyvinylchloride	27.2	
	foam	polyethylene	7.5	
	strap	polypropylene	15	
	labels	paper	1.8	
	seal	acrylate	0.2	

SINGLE IN-LINE POWER PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT157	DBS9P	4.8	12 × 23.7 × 4.4
SOT141	DBS13P	4.8	12 × 23.7 × 4.4
SOT243	DBS17P	4.7	12 × 23.7 × 4.4
SOT131	SIL9P	4.8	12 × 23.7 × 4.4
SOT193	SIL13P	3.0	12 × 23.7 × 4.4

All single in-line power type packages have a similar composition, quantities may vary

Chemical content

Group representative: SOT243 (DBS17P)

SOT243	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	CuZn15, Ni+Ag spot plated	19.5	
	heatsink	Cu, Ni plated	50.3	or bare copper
	soft solder	SnAg25Sb10	0.2	
	solder layer	Sn or Sn/Pb	< 0.2	
crystal	active device	doped Si	< 0.6	
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	29.2	
Packing material			(g)	PQ = 552
tube pack	box	cardboard, carbon coated	145	
	tubes	polyvinylchloride	1056	24 tubes/box
	end plugs	polyvinylchloride	28.8	
	foam	polyethylene	8.3	
	strap	polypropylene	0.7	
	stickers	paper	1.7	
	seal	acrylate	0.2	

SMALL OUTLINE PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT96	SO8	0.080	3.9 × 4.9 × 1.3
SOT176	SO8	0.290	7.5 × 7.6 × 2.3
SOT108	SO14	0.130	3.9 × 8.7 × 1.3
SOT109	SO16	0.152	3.9 × 9.9 × 1.3
SOT162	SO16	0.400	7.5 × 10.2 × 2.3
SOT163	SO20	0.520	7.5 × 12.7 × 2.3
SOT137	SO24	0.600	7.5 × 15.3 × 2.3
SOT136	SO28	0.740	7.5 × 17.8 × 2.3
SOT213	SO28	0.900	8.4 × 18.0 × 2.6
SOT158	VSO40	0.540	7.6 × 15.4 × 2.3
SOT190	VSO56	1.300	11.1 × 21.6 × 2.8
SOT266	SSOP20	0.092	4.4 × 6.5 × 1.3
SOT339	SSOP20	0.153	5.3 × 7.2 × 1.7
SOT340	SSOP24	0.178	5.3 × 8.2 × 1.7
SOT341	SSOP28	0.240	5.3 × 10.2 × 1.7

All SO packages have a similar composition, quantities may vary

Chemical content

Group representative: SOT213 (SO28)

SOT213	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	Cu alloy, Ag spot plated	20.9	
	solder layer	Sn/Pb	3.5	
crystal	active device	doped Si	2.6	
rubber	chip coating	silicone gel	1.3	optional
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	71.7	
packing material			(g)	PQ = 1000
reel-pack	box	cardboard, carbon coated	174	
	reel	polystyrene	220	
	carrier tape	polystyrene, carbon loaded	150	
	cover tape	polyester	22.3	
	stickers	paper	2.1	
	seal	acrylate	0.2	

PLASTIC LEADED CHIP CARRIER PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT261	PLCC28	1.170	11.5 × 11.5 × 4.1
SOT187	PLCC44	2.280	16.6 × 16.6 × 4.1
SOT238	PLCC52	2.917	19.1 × 19.1 × 4.1
SOT188	PLCC68	4.700	24.2 × 24.2 × 4.6
SOT189	PLCC84	6.680	29.3 × 29.3 × 4.6

All PLCC packages have a similar composition, quantities may vary

Chemical content

Group representative: SOT187 (PLCC44)

SOT187	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	Cu alloy, Ag spot plated	17.1	
	solder layer	Sn/Pb	1.1	
crystal	active device	doped Si	3.2	
rubber	chip coating	silicone gel	1.1	
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	77.5	
Packing material			(g)	PQ = 1300
tube pack	box	cardboard carbon coated	145	
	tubes	polyvinylchloride	1050	50 tubes/box
	foam/plate	polyethylene	15.3	
	plugs	styrene-butadiene rubber	126	
	strap	polypropylene	0.7	
	stickers	paper	1.8	
	seal	acrylate	0.2	

QUAD FLAT PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT205	QFP44	0.920	14 × 14 × 2.2
SOT307	QFP44	0.464	10 × 10 × 1.7
SOT196	QFP48	0.464	10 × 10 × 1.7
SOT208	QFP64	1.560	14 × 20 × 2.7
SOT219	QFP80	1.560	14 × 20 × 2.7
SOT210	QFP100	1.560	14 × 20 × 2.7
SOT220	QFP120	5.100	28 × 28 × 3.3
SOT280	QFP128	5.100	28 × 28 × 3.3
SOT225	QFP160	5.100	28 × 28 × 3.3

All QFP packages have a similar composition, quantities may vary

Chemical content

Group representative: SOT208 (QFP64)

SOT208	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	FeNi42 or Cu alloy, Ag spot plated	21.2	
	solder layer	Sn or Sn/Pb	0.6	
crystal	active device	doped Si	1.3	
rubber	chip coating	silicone gel	0.6	optional
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	76.9	
Packing material			(g)	PQ = 640
tray pack	box	cardboard, carbon coated	100	
	JEDEC – trays	copolymer, carbon loaded	1050	
	foam	polyethylene	15	
	labels	paper	0.8	
	seal	acrylate	0.15	
	strap	polypropylene	1.5	

SHRINK QUAD FLAT PACKAGES & LOW PROFILE QUAD FLAT PACKAGES

Philips package type code	Package name	mass (g)	body (mm)
SOT313	LQFP48	0.180	7 × 7 × 1.4
SOT314	LQFP64	0.320	10 × 10 × 1.4
SOT315	LQFP80	0.450	12 × 12 × 1.4
SOT316	SQFP208	2.500	28 × 28 × 3.4

All SQFP & LQFP packages have a similar composition, quantities may vary

Chemical content

Group representative: SOT315 (LQFP80)

SOT315	source	substance	mass	remark
Device part			(%)	
metal parts	leadframe	Cu alloy, Ag spot plated	31.1	or NiFe42
	bondwires	Au	1.1	
	solder layer	Sn/Pb	11.0	
crystal	active device	doped Si	9.0	
plastic	envelope	partially-brominated epoxy, SiO_2 (<72%) Sb_2O_3 (<3%)	47.8	
Packing material			(g)	PQ = 595
tray pack	box	cardboard, carbon coated	100	
	JEDEC – trays	copolymer, carbon loaded	1050	
	foam	polyethylene	15	
	stickers	paper	0.8	
	strap	polypropylene	1.5	

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